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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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De Reaumur (1683-1757).

Many factors render some notes on the life and work of the great French savant De Reaumur, particularly *apropos* this year. In the first place, it is the bicentenary of the publication of his work on "L'art de convertir le Forgé en acier et L'art d'Adoncir le Fer Fondu," or, roughly translated, the art of converting iron into steel and softening cast iron. In the second place, there is a renaissance in the malleable castings industry, of which he was the originator. The third reason is that at least some British foundrymen will go to Paris next September, and no doubt they will have an opportunity of inspecting a copy of his book. This, by the way, has already been handled by some of the members of the Institution of British Foundrymen, through the courtesy of Mons. Ramas, the President of the Association Technique de Fonderie (France), who brought a copy with him on the occasion of the Birmingham Conference.

The current issue or "La Revue de Métallurgie" contains a short biography by Mons. Leon Guillet, and a *resumé* of his epoch-making book by Mons. J. Cournot.

Réne-Antoine Ferchault, Esquire, Lord of the Manors of Reaumur, Angles and Bermondière, Commander of the Royal and Military Order of Saint Louis and of the Royal Academy of Arts of Rochelle, Member of the British, Prussian, and Russian academies of science and of the Institute de Bologna, was born at La Rochelle in 1683. After primary education in his home town, he went to the Jesuit College at Poitiers, and leaving there in 1699, he studied the law at Bourges. In 1703, attracted by mathematics and physical sciences, he went to Paris, where he remained the rest of his life. At the age of 25 he published his first two theses on geometry.

If the whole of Reaumur's works are considered, one cannot help being amazed by the diversity of subjects studied, this bearing a singular comparison with those of Bessemer, but to Reaumur can be given the palm for being more scientific and methodical.

He studied successively the structure of various animals, the possibility of using spider webs as silk, showing that, contrary to recent research, they could not be used; the manner by which various marine bodies, mussels, star-fish, etc., attach themselves to solid bodies; he also discovered how certain fish lay eggs, which, when crushed, yield a yellow colour, becoming, after rapid exposure, a glorious purple, useful as a dye.

He proved that certain shell fish, when deprived of a limb, quickly grow another, and set forth the exact circumstances surrounding this reproduction. Another study was the conservation of eggs by coating with substances capable of closing up the pores of the shell.

In 1734 to 1736 various books on insects were published dealing successively with caterpillars, butterflies, moths, flies and bees. His last communication to the Academy was on the subject of the manner in which birds build their nests.

Another subject which interested him was the force necessary to support a cord. He strove to find whether it was greater than the sum of the forces necessary to support its threads. He decided that it was less, and further stated that the less twisted the threads the stronger it should be. Lustre for imitation pearls, he showed, could be obtained from a material extracted from white-bait, and found that real pearls are derived from a disease in the oyster.

However, the name of Reaumur will not be remembered for the above studies, but for his invention of the process of making malleable iron castings.

Something of his public-spirited character is shown by the fact that when offered a pension of twelve thousand pounds he gave this to the Academy to form what was, perhaps, the first research fund ever opened. In the preface to his book Reaumur states that he has been reproached for not having kept his discoveries secret, and insists that it is his first duty to consider the general good of society.

Whilst the method of making cemented bar steel was known before his experiments, he explains that the process was kept secret, and he had to start with no material whatever to work upon. Finally, he evolved two satisfactory carburising mixtures, the first consisting of 2 parts of soot, 1 part of charcoal, 1 part of ashes, and a little less than three-quarters of a part of rock salt, and the other a similar mixture, but with 2 parts of ashes.

The researches on malleable we hope to detail in a future issue.

Reaumur died at the age of 75 whilst on a visit to Bermondière.

To-day metallurgical conditions are such that everything points to a distinct revival in the industry which this famous savant initiated.

Steam Turbine Parts.

By S. G. Smith.

Cast-Iron Diaphragms for Steam Turbines.

This class of work is restricted to the comparatively few engineering firms who manufacture impulse-type steam turbines. The diaphragms are usually made in cast iron with mild steel blades. They are usually split on the horizontal centre line with spigot and socket joints, being machined to prevent leakage from one side of the diaphragm to the other. In Fig. 1 B shows a diaphragm arranged for partial admission, C a diaphragm with full admission, whilst A depicts the half diaphragms in position in the top half of the turbine cylinder.

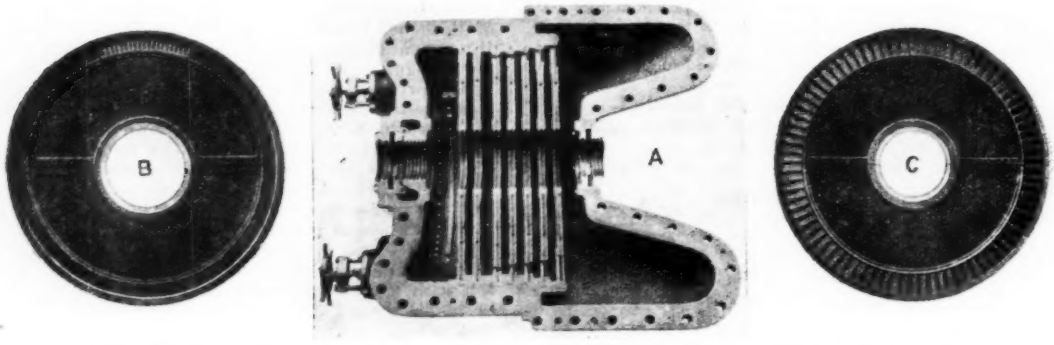


FIG. 1.—A SHOWS DIAPHRAGM BOX; B ARRANGED FOR PARTIAL ADMISSION, AND C FULL ADMISSION.

In its passage through the earlier stages of a compound turbine the volume of steam is comparatively small, but as the pressure falls through the machine the volume increases considerably in the later stages. The mild steel blades which are cast into the diaphragms are suitably shaped to form nozzles in which the steam expands, and in expanding attains a velocity which is utilised on the rotating wheel which follows each diaphragm.

The sequence of operations throughout the various stages of the turbine is as follows:—The steam is first passed into a steam chest containing the governor and emergency valves which control the output and speed of the machine. It then passes to a series of nozzles, which are usually machined from mild steel and secured to the inside of the turbine casing. Steam expands in these nozzles, and the resultant velocity is utilised on the first rotating wheel. The steam by this time has been brought practically to rest again, and it is expanded in the nozzles fixed to the first diaphragm. In order that these nozzles may be of a reasonable height they are restricted to a small arc of the diaphragm. In expanding in the diaphragm nozzles the steam again increases in velocity, and the kinetic energy it thus acquires is utilised on the second rotating wheel. The steam having been brought to rest again on this wheel is again expanded in the next diaphragm, and so on until the exhaust stage is reached. After passing through the first or second diaphragm the pressure of the steam has been reduced considerably, and the volume correspondingly increased. It is therefore necessary to cast the nozzles into a larger arc in the second diaphragm than in the first, and in the third or fourth diaphragms steam will be probably admitted round the whole circumference of the diaphragms. As the steam continues to fall in pressure beyond this stage, and consequently increases in volume, the height of the nozzles cast into the diaphragm must be increased to allow a sufficient area for the passage of the steam. Fig. 2 shows a velocity wheel and nine Rateau wheels mounted on the spindle.

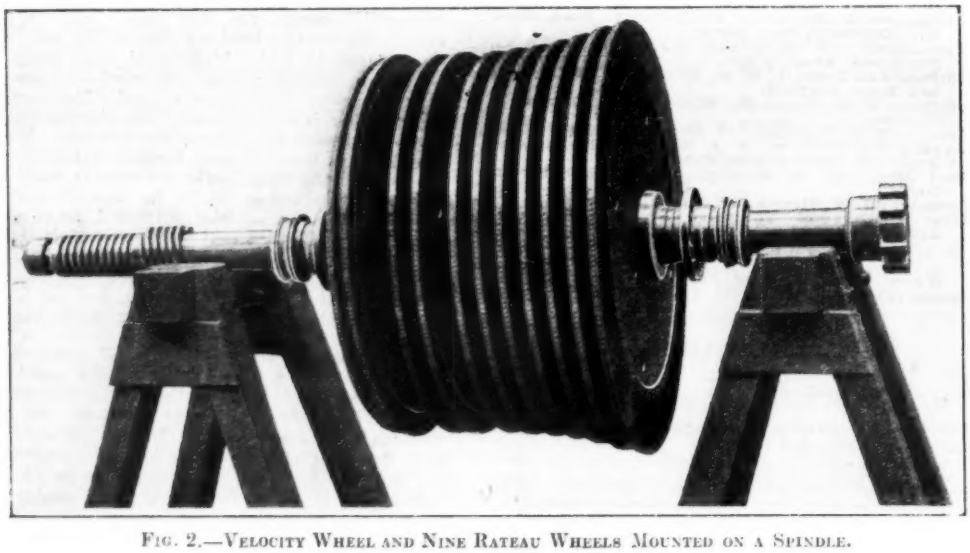


FIG. 2.—VELOCITY WHEEL AND NINE RATEAU WHEELS MOUNTED ON A SPINDLE.

In Fig. 3 A is an enlarged section of the rim of this wheel, and B an enlarged section of the Rateau stages. This type of rotating wheel is usually employed for all except the first stage.

(Fig. 3) C shows a sectional arrangement of the high pressure nozzles and velocity wheel and three diaphragms and Rateau wheels.

Fig. 4 shows a complete half diaphragm suitable for one of the low pressure stages.

The diaphragms vary from 12 in. to about 9 ft. in diameter, depending upon the output of the machine, and in thickness from ¾ to 3 in., depending upon the pressure difference on each side of the diaphragm; for very high pressures or temperatures cast steel diaphragms are used. The number of diaphragms required per machine varies considerably with the steam pressure and temperature, vacuum or terminal pressure, and with the efficiency of the machine.

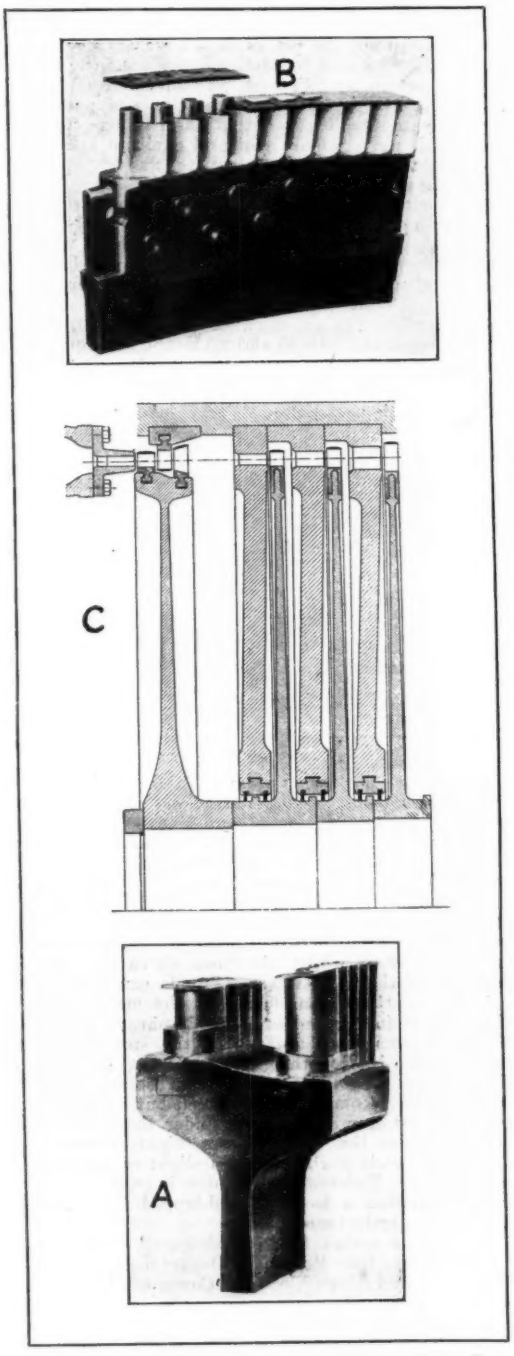


FIG. 3.—A IS SECTION OF THE WHEEL RIM; B A SECTION OF THE RATEAU STAGES, AND C THE ARRANGEMENT OF THE DIAPHRAGM AND RATEAU WHEEL.

Diaphragms may be either plain or dished and the height of the nozzles may be anything from ½ in. upwards. The weight varies, of course, with the diameter and thickness.

Method of Moulding.

Diaphragms, the supervision of which have come under the writer's supervision, have been made in green sand, dry sand, and loam. For those made in green sand the half patterns were fixed to follow-boards and moulded by semi-skilled men. Those made in dry sand were made from loose half-patterns by skilled moulders. The largest diaphragms were struck up in loam from strickles with an eccentric spindle, thus two large half diaphragms were swept up at one time, the eccentric race of the spindle allowing a dividing core, 6 in. wide, between the half diaphragms. This dividing core was formed by a loose making-up piece. So far as moulding is concerned, each of the above methods have reached a high standard of efficiency.

Core Making.

The cores which form the bladed parts or steamway passages, whether narrow or wide, are made in segments from core boxes. These cores are chiefly made by female labour, the exceptions being the very large cores, which are made by male coremakers, as they are too heavy for the former. The making of these cores call for the highest skill and care. It is an art-craft in itself, and efficiency in the operations can only be attained after long practice, with either men or women. It should be stated that the method adopted by some makers is by the use of a wheel machine. There are several makes of wheel machines that can be applied, and give great accuracy in setting the height and pitch of the blades. This process being continuous, it obviates joints and possible errors when making and assembling segment cores. But, apart from this aspect, cores made from a box are an advantage. The writer is not making this statement haphazard, as he realises quite well the general advantages of the wheel moulding machine, having had personal experience with them. He has arrived at this conclusion only after a full exchange of views with men who have used the wheel moulding machine for this purpose. When 50 to 60 half-diaphragms are made per week from small diameters up to 9 ft. diameter it would mean the employment of a large number of moulding machines; at the same time, efficiency and accuracy should not be sacrificed when deciding methods of moulding. With the segment cores most of the errors that can arise are under control.

Inspection.

The castings must be quite clean, both machined and unmachined surfaces. The metal must be dense and free from any areas of dross on all parts of the casting. To ascertain this, the castings are heavily hit with a steel-pointed hammer every 2 or 3 in. throughout the surface. If a casting is deformed in the slightest degree it is scrapped.

The least indication of fusion of the steel blades, any signs of looseness, or cold lap of the iron, small shot, etc., they are scrapped. The pitch and height of the blades must be accurate. A margin line is scribed around the inside and outside diameter of the port or steam passage; if this line deviates more than 1-32nd part of an inch the castings are rejected. Every blade, and every inch of the casting is minutely examined for possible defects. This is carried to such an extent that sometimes a magnifying glass is employed. These are the demands of the engineer respecting these castings. They are satisfied by the foundry; but this state of affairs has not been the work of a short period. It has been a matter of evolution during several years.

Runner Gates.

The runner gates must not impinge on the steel blades in the passage core. If this happens the blades will be fused. The gates must not beat against cores; that will cause a commotion with the molten iron, and possibly an accumulation of dross. The best position for the runner gates is underneath the cores, as the metal is then evenly distributed, and undoubtedly gives the most satisfactory results.

Pouring and Temperature Considerations.

The rate of pouring and temperature of the metal should, to some extent, be governed by the width of the port cores. If the port core be a very narrow one, say, from ½ in. to ¾ in. wide, the rate of pouring need not be so fast, or the temperature of the iron be so high, as when pouring a diaphragm with a very wide port.

XUM

In the case of the narrow-port diaphragms which have a fairly thick plate, say, 2 in., if the temperature is too high the ends of the blades projecting from the core will be liable to fuse, and the very narrow core may be penetrated by the very hot metal. In the wide port diaphragms, say, up to 24 in. wide, the grating must be ample, and the temperature of the iron high. If these two conditions are not complied with the result will be

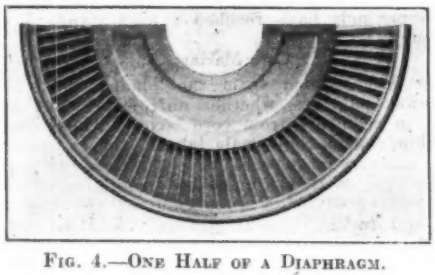


FIG. 4.—ONE HALF OF A DIAPHRAGM.

in the narrow port diaphragm, fusion of blades and part fusion of narrow core. With the wide port diaphragm, cold-shut and cold-lap around the blades it is necessary to acquire a suitable temperature for pouring, the range may be in the region of 1,300 to 1,400 deg. C.

Analysis of Iron.

A suitable composition of iron is CC, 0.67; GrC, 2.95; Si, 1.42; Mn, 0.66; P, 0.50; and S, 0.09 per cent.

This analysis is representative of the iron used for these castings. It is capable of giving a high-temperature fluid iron. The half diaphragm castings are often tested for deflection, hence the iron must be strong and dense. A tensile test-bar from the above analysis showed 12.33 tons per sq. in., and the transverse bar 2,470 lbs. per sq. in., with a deflection of 0.075 in. and a Brinell hardness number of 229. All these tests are recorded daily.

Deflection.

It is imperative that no deflection in the plate or blades should occur under steam pressure owing to the small clearance allowed between the diaphragms and the movable wheels, which is necessary for the efficient running of the turbine, hence as a precautionary measure against this occurrence certain pairs of half diaphragms are tested for deflection, as shown in Fig. 5. One, two and three 9-in. rams are used respectively for certain

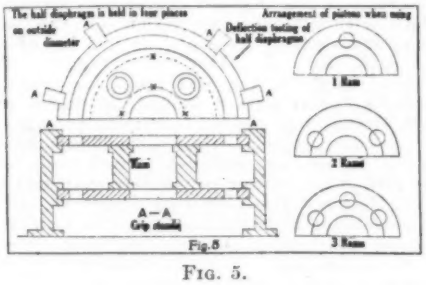


FIG. 5.

diaphragms. The pressure varies from 100 lbs. to 600 lbs. per sq. in., according to instructions received from the engineer's office. The micrometer measurements are taken from points indicated by small crosses before and after the pressure is applied.

Design of Steel Blades.

During the writer's experience with these castings several different types or design of blades have been used. Sometimes an altered type of blade brings in complications from a foundry standpoint. This aspect will not be enlarged upon, as such complications are always overcome. When it is considered that some blades are 24 in. long by 2½ in. deep, and that over 100 blades are cast in a diaphragm, some consideration is needed to escape possible evil effects.

Fig. 6 shows a reinforced diaphragm blade, which is now becoming general owing to its strength, which is derived from the loop. With this design special precaution has to be taken with short blades due to small air pockets in the loop.

Coating the Blades.

There is nothing better than a perfectly clean blade for the molten metal to rest against. But that is impracticable for several reasons, the chief reason being that the steel blade being continually in moist, or humid, atmosphere, very soon rusts. It is not intended to consider the composition of rust, but when molten iron comes into contact with it it is like putting a light to gunpowder. A gas is created, and gas holes are trapped and found in the casting.

An early experience may prove interesting. The cores containing the blades in some instances had been made months beforehand, consequently the blades were thick with rust, and in this condition they were being put into the moulds and poured, with the inevitable result that the castings, when machined, were full of shot and cavities, and, to the writer's amazement, surprise was expressed when the castings were returned.

The writer has occasionally ordered the cores to be broken up on this account, and instructed that all blades must be cleaned in future, also, when there is no coating on the blades, the cores should not be put into work until the the mould is on the way.

Sherardising is an excellent coating to protect the blades from rusting, and no doubt it also prolongs the good condition of the blades when in

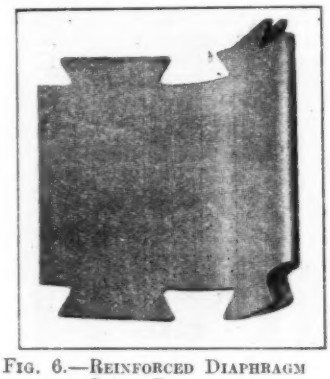


FIG. 6.—REINFORCED DIAPHRAGM GUIDE PLATE.

work, minimising the penetration and pitting by the superheated steam; but zinc being incorporated in its composition the molten iron does not rest quietly against it. Probably a tin covering would meet the requirements, as it prevents rust forming, and the molten iron will not hold off it, providing the part of blade exposed to the iron is dry. Zinc volatilises below the temperature of molten iron, whilst tin fuses above the temperature of the hottest iron a cupola can melt.*

It is sometimes imagined that the molten iron that covers in the ends of the diaphragm blades should in some way unite with the steel blades. Such an idea is altogether wrong. If that occurred the end of the blade would be carbonised, and consequently become no longer steel, but a material equal to cast iron only. Even under the best conditions, when the molten iron tightens firmly around the ends of the blades, a slight carbonising takes place. Unfortunately, there is only a small margin between a loose or cold-lapped blade and a fused or partly fused blade.

The writer wishes to acknowledge the courtesy extended by the Publicity Department of the Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester, for permission to use the illustrations embodied in this article.

HYDROGEN GAS CYLINDERS. — Mr. Alex. E. Tucker, reporting on the explosion of hydrogen cylinders at the works of Messrs. J. W. Ellis & Company, of Newcastle, found in the cylinder, which he believed to have caused the explosion, 0.49 per cent. of copper. He based his belief partly on a microphotograph, which showed internal cracks and an entire absence of annealing. Mr. Tucker points out that the high copper content is characteristic of German steel. The full report is set out in the June issue of "Industrial Gases."

* [We cannot understand our contributor's statement, as tin melts at 232 deg. C.—Ed.]

An Apprenticeship Course in Foundry Practice.—VIII.

By Ben Shaw and James Edgar.

READING DRAWINGS AND SETTING DOWN WORK.

It may be as well to make it quite clear, at the beginning of this article, that it is not a disquisition on mechanical drawing. To attempt such would be to go quite beyond the scope of this series, although we shall, in a subsequent article, deal with geometrical drawing for both pattern-maker and moulder, including development of surfaces. The proficient patternmaker must be an efficient draughtsman, with a good knowledge of the principles of machine construction and design. This applies also to the moulder, but to a lesser degree, because machining allowances and modification in design are usually determined while the pattern is under construction. In addition to machine design, however, every patternmaker and foundryman should have a knowledge of what may be termed practical workshop drawing, including under this term the reading of drawings or blue prints, the making of workshop drawings, and dimensioned sketches. A knowledge of sketching is useful to the moulder when making grids, while he is greatly handicapped in setting cores before closing a mould if he cannot check work, either from the patternmaker's drawing-board or from the blue print. It is customary in many foundries for the patternmaker to stand by while a mould is being closed and test thicknesses as the mould is being assembled, but the moulder ought to be able to do this himself. The loam moulder must either be in constant consultation with the patternmaker or able to read drawings.

Setting out work is one of the most important tasks of the patternmaker. Many apprentices fall into the bad habit of simply copying a blue print with only the haziest notion of the design of the job until they have one or two views drawn. This method leads to many errors and much redrawing. It is also slower than getting a thorough grasp of the main features of the work at the commencement.

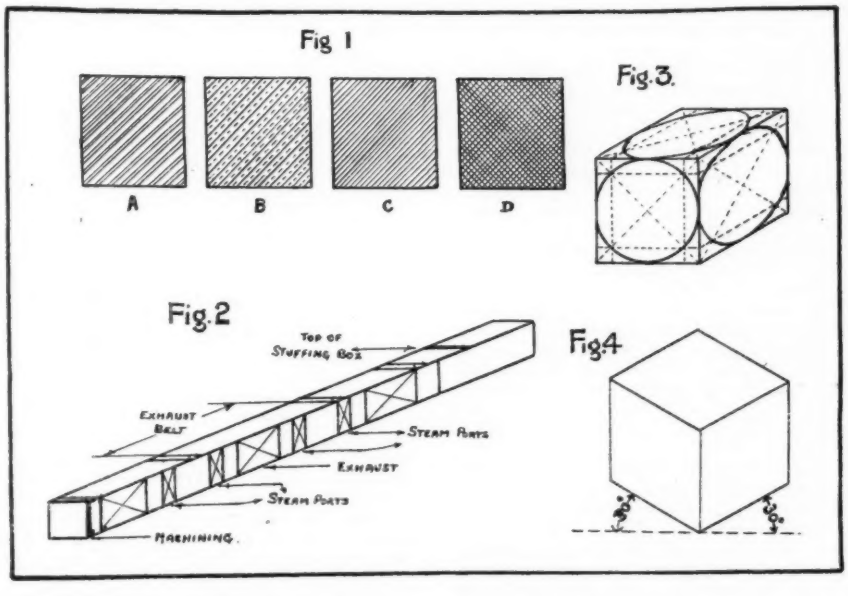
Mechanical Drawings.

A mechanical drawing may be defined as the principal means or language by which the inventor or designer conveys his requirements to the craftsman of the various shops. The number of views shown on a drawing or blue print depends to a large extent on whether the job is simple or intricate. If the shape is very irregular, or there is much coring, more views are necessary. A plan is a view looking on top of an object, while an inverted plan is a view looking on the bottom. Elevation may be described as front, rear, and side views, while sections are drawn to show coring or shapes that are not clearly indicated on outside views; it is supposed that the casting is cut through on a certain plane. Sections are invaluable for giving metal thicknesses. In addition to the main views, part views, sometimes called "scrap" views, are given of details, because, while a drawing to small scale may be convenient for the main parts of a job, a larger scale drawing may be necessary to show all the dimensions of an intricate part. The patternmaker must also follow out the practice when making his own working drawing, but, before we explain setting out methods in detail, we shall treat of the important subject of reading drawings.

Reading a Drawing.

The mental attitude of a moulder, when he receives a pattern and a drawing board in the foundry, should be similar to that of the patternmaker when he receives a blue print from the drawing office, hence much that is said here is of equal value to moulders and patternmakers.

It is not advisable, unless when work is very simple, for the patternmaker to prepare a drawing board until he has read the drawing carefully and is thus able to decide intelligently how many views it will be necessary for him to set out. It may be advisable, when dealing with a difficult job, to spend an hour or two in a preliminary comparison of views. It is wise to ignore dimensions until the general shape of the object is fixed in the mind, although it may be a help to memorise one or two of the overall sizes. There should be no consideration of construction methods at this point, all the attention being concentrated on the design. The highly skilled and experienced man may successfully determine construction while he is studying design, but the apprentice and the young journeyman will be well advised not to do so. When the general outline is clear and branches and main cores have been made out, it is advisable to study details, such as deviations from a regular outline, which may have a very important bearing on the construction of the pattern, bosses, facings, ribs, etc. Too much care cannot be taken at this stage, and each view should be examined closely, because draughtsmen are not infallible, and important details may be missed on two views and be shown on a third, and it is peculiar, but true, that if one fails to notice a boss during the first examination, then, by a defect in vision, it will probably not be seen during much subsequent



examination. Even clever craftsmen have often a difficulty of interpreting parts of a drawing, and find it necessary at times to project points from one view to another with rule, dividers, or straight-edge. The ability to visualise a pattern or casting is a great help, and skill in doing so should be assiduously cultivated.

The design of the job being thoroughly understood, it is necessary to look carefully at the various dimensions with a view to deciding how the pattern should be made. If an original drawing or tracing has been supplied, the brass, iron and steel parts can be separated by the section lining. A, B, C, and D in Fig. 1 represent the section lining for steel, brass, cast iron, and white metal respectively, but this method is gradually falling into disuse, the more reliable method being to have the material list printed on the drawing, and this practice is particularly desirable when blue prints are supplied.

The construction of the pattern and core-boxes cannot be definitely decided upon yet, but it is as well, before starting to set down the work, to form a general idea of the kind of pattern necessary, taking into consideration the number of castings required. Moulding difficulties have also to be considered.

A final examination of the drawing should be made before starting to set down in order to decide machining allowances, where slight modifications may be necessary—although this can be done when actually setting down the work—and also tool clearance. The latter is very important, and not always allowed for in the drawing office.

Setting Down Work.

A workshop drawing is not simply a copy of the draughtsman's drawing or an enlargement to full size. In setting out a valve chest, for instance, the cover, valve, valve seat, spring, if a spring-loaded valve, would all be left off, but the precaution of finally examining the setting-down in order to leave machining allowance is necessary. Then, also, some drawings are burdened with details which would only be confusing if placed on a workshop drawing at the beginning of a job, although it may be necessary to add them before the pattern is completed. In no cases should sizes be "scaled" from a blue print or from a tracing. When there is any doubt about a size, the draughtsman should be appealed to; so also when two views conflict.

Patterns are always set down full size and drawn larger than the dimensions given to allow for contraction, so that parts of the pattern or the whole pattern may be tried on top of the drawing or, if this is impossible, as when making large patterns on which many men are engaged, sizes may be transferred from the drawing board to the timber, and, if accurately made, the various parts will ultimately join together and give overall dimensions correct. The apprentice should set down every job, although it may not be necessary for experienced men to do so.

Drawing Boards.

There are several types of drawing boards in use in pattern shops. Plywood is occasionally used, and a neat drawing can be made on it, because there are no open joints, and it does not shrink or swell perceptibly. For large work boards in two parts hinged together are used in some shops, as they occupy less room when not in use. The most common type of drawing board is that made of 1-in. yellow pine boards jointed and battened. For small work some patternmakers still chalk boards in the old-fashioned way, but planed surfaces are much more satisfactory. The black painted board is unsurpassed for large work, because French chalk lines stand out distinctly.

The number of views that should be set out depends on the design of the work, the skill of the patternmaker, and whether several men will be employed on the job. In some cases a front elevation will be the only view required, and clever craftsmen who are able to visualise sections can dispense with much drawing. The man who sets out the drawing is in a favoured position, and not so much should be expected from others who may afterwards be transferred to help in the construction of the pattern, therefore additional sectional views and elevations will be necessary. It is always better to draw an additional view if a design is awkward.

The principles of setting out are the same for small as for large work; thus it is as difficult to set out, say, a carburettor as a large marine cylinder. Even greater accuracy is necessary for small work, because of thinness of the metal and the small areas, but if a mistake is made on a large drawing board it may be very costly to remedy the pattern if undiscovered until the final checking, before being sent to the foundry. The value of centre lines cannot be over-estimated. Some patternmakers use the gauge and try-square for laying down centre lines, while others describe a longitudinal line with a straight-edge, and draw all other lines geometrically from it. For small work the gauge and try-square are very convenient, while for large work, provided the edge of the board is quite straight and the try-square true, it is immaterial whichever method is adopted. If a design on both sides of a main centre line is the same, it may be advisable to draw a sectional view on one side. Some patternmakers draw several views on top of each other, a practice which may be necessary when dealing with very large work, but not generally advisable. In some cases work is set down on the patternshop floor and the drawing used for building on. It is very difficult to make a really accurate drawing on the floor, however, and the practice is only admissible for large work, such as ship construction patterns, the dimensions of which may be varied somewhat from the drawing.

The Length Rod.

A very important aid for setting down work are length rods, which are also invaluable for screwing up patterns that have been dissembled at the foundry, and also, on occasion, for testing cores in position. They are only used for what may be termed medium and large work. In most patternshops an assortment of length rods is kept in stock. For standard patterns the length rods are never destroyed, and it is customary not to deface a rod until the casting has passed the marking off table. Length rods are made from 1½ in. to 2½ in. sq., according to length, and dimensions are usually marked from one end, which, when testing heights, enables the patternmaker to rest the rod on the floor. For testing horizontal sizes it is often necessary, however, to mark the rod from a centre line, thus two faces might be 6 ft. from either side of a centre, and greater accuracy is secured by marking from a centre line than from an end. When a length rod has been selected, one side is reserved for heights, one for lengths, another for widths, and the fourth side may be used for boss and other centres that, to avoid confusion, have not been marked on any of the other sides. Lines should be marked across the rod with the scriber and a description printed. Rods should be varnished after they are marked off to protect the printed descriptions. Fig. 2 shows the height side of a length rod for a L.P. marine cylinder.

Although length rods are in use in all patternshops where large work is constructed, the method of making them differs. In some cases they are marked from the drawing board, but we prefer the method of making the length rod before a single line is set down on the board and transferring centres from the rod to the board. This is the most scientific way, and the length rod is a measuring instrument until the mould is closed in the foundry.

Should pattern construction lines be shown on a workshop board? In some cases it may be necessary to do so, but they should be as few as possible, and they should not be chalked or pencilled in, as this may lead to confusion and mistakes. It is much better if construction lines are wanted to make another setting-down of the part required on a separate board.

Strickles.

When making sweeping boards, etc., for loam moulding, a drawing board is invariably unnecessary, as each sweep made is really a drawing board, and the moulder has not much difficulty, as a rule, in understanding the various sweeping boards. When the loam mould has to be built, with ribs, bosses, and branches set in, it is advisable to draw an elevation—or plan—on one of the boards to which the moulder can refer. This need

not be a full-sized drawing, as it is only used to indicate the position of minor details.

Colouring Working Drawings.

All workshop drawings should be coloured in some way to make the various views stand out clearly. Even when the views do not overlap it is advisable, but when varying sections are drawn over each other it is essential if mistakes are to be avoided. When the drawing is not to be sent to the foundry section lines may be roughly sketched in with coloured chalks, varying the colour for each section, but when it is essential that they be sent to the foundry with the pattern it is better practice to varnish the various sections, using colouring pigments with the varnish to make the views distinct. Not only sectional lines, but lines determining plan or elevation, should be carefully coloured corresponding to the view they represent, and, in many cases, dotted lines can be introduced for important parts or metal thickness not shown in section. In every case the machining allowance should be distinct in colour from its corresponding section; this is useful as a check to the patternmaker, and it is valuable to the moulder. There is less time wasted in searching for lines when the drawing is varnished, and it is worth while preparing a good drawing, especially if many men will be engaged in the construction of the pattern, in order that the possibilities for errors may be reduced. The sections drawn upon loam boards must be painted or varnished to be of any value to the moulder.

Old Patterns and Castings as Guides.

A word may be said here about examining old patterns and castings with a view to discovering former practice. Some apprentice patternmakers cultivate the bad habit of going to the pattern stores and carefully copying the methods adopted in making similar patterns previously. This is a banal practice which kills initiative, and when faced with something for which a model is not available, the apprentice cannot decide what to do. It is almost as bad for him as the practice of some foremen explaining every detail of construction and moulding to prevent loss of time. Much can be learnt from the careful examination of old patterns, both of what is wrong as well as what is right. It is slavish imitation that is wrong. Even a highly skilled craftsman may learn much from comparison of his own work with the work of others. It is also useful after one has decided on the construction to examine a similar pattern. On large work it occasionally happens that modifications have to be effected to facilitate moulding after a pattern is complete or even in the foundry, owing to difficulties presenting themselves that were not anticipated, and an examination of an old pattern may reveal such alterations.

With regard to construction, a good deal can be learnt from an inspection of castings. The perfect casting could show no indications of mould joints, but such perfect castings are seldom seen. It is nearly always possible to trace joints, and if there is no opportunity of watching a pattern being moulded the casting can be seen when it comes from the foundry. The patternmaker who previously visualised the moulding operation can thus compare his ideas with the moulder's work. He has to bear in mind, of course, the possibility that another moulder might adopt different methods. The young moulder can also learn much from closely inspecting castings whenever he has the opportunity, although he is in a similar position to the young patternmaker who goes to the pattern store; he should form a general idea before examining the casting for joints. One of the most valuable habits that the apprentice can form is to keep a commonplace book and enter in it particulars of any new type of job. It need not occupy much time to make two or three freehand sketches and a brief description, with the time taken for construction and the timber used. The value of this is not merely that a book of reference is obtained, but writing down such particulars impresses them in one's mind. A keen observer sees many little "gadgets" and devices in the course of a week that are worth noting. An apprentice should never allow an opportunity to pass of examining work that has been executed by men who are recognised as being above the average in skill, because such men do not confine themselves to stereotyped methods.

Sketching.

Very early in his career the young patternmaker finds it necessary to make sketches. Not many moulders make sketches, nevertheless the ability to sketch is of use to them, and those who have the ability find sketches a great help to them.

Mechanical drawing is called orthographic projection, and sketching may be in the form of orthographic projection, or a pictorial representation by means of oblique or isometric projection. A sketch may be defined as the drawing of an object exactly as we see it. The patternmaker has almost continual need for sketching, and especially so in repair shops, in ship work, and in textile mill work. We have known many cases where a sketch by a foreman has conveyed his ideas to the workmen far better than a long explanation. It is a common occurrence for a patternmaker to be sent to a ship, a mill, or elsewhere, to get particulars for the construction of a new pulley, a bracket or a pipe. Sometimes a whole line of pipes is required, and the patternmaker has to make sketches and determine metal and flange thicknesses, taking into consideration steam pressure, etc. There are also occasions when a new pattern has to be modelled on a casting, which is some distance from the pattern shop, and it may be necessary to make several sketches before setting the work out properly.

No hard and fast rule can be made as to when orthographic projection and when pictorial representation should be used; when getting particulars for a pipe line it may be necessary to make one or two views orthographically projected of each pipe, but, it may also be of great assistance afterwards to draw a pictorial view of the whole pipe line showing joinings. A pictorial view does not lend itself to dimensioning very well. It is sometimes helpful, when making an elevation and plan of the required casting, to make a pictorial view of the place where the casting is to be fitted. The peculiar value of pictorial representation is that it conveys a fuller conception of what is required than several rectangular views, and if, as is the custom in some pattern-shops, one man does all the outside work, and the actual construction of the pattern is done by others, it makes the occurrence of mistakes less likely.

The apprentice should practice sketching on squared paper, although in the pattern-shop odd pieces of timber have to be used, and in the foundry the moulder, when he wants to make a sketch, uses the outside of a core-box or a discarded drawing board.

Drawing a Cube.

On all sketches from which a workshop drawing will have to be made the dimensions should be carefully marked, and where there is no room for dimensions, indicating letters A, B, C, etc., should be used and the equivalents written underneath thus: A—1½ in., B—7 in., C—4⅞ in.

Fig. 3 is an oblique projection of a cube, and it will be observed that one face is shown in its true shape and correct dimensions which is very helpful for many purposes. In our previous article "Notes on Patternmakers Tools," the ordinary bench gauge and also the panel gauge were drawn in oblique projection, while the thin circle gauge, the bench tool rack, etc., were in isometric. To return to the cube, lines parallel to the line of vision, which would be shown in a rectangular elevation as a joint, are shown in an oblique projection by a full length line running at an angle to the horizontal. The angle is called the angle of "tilt," and is determined by consideration of which side it is most important to show up, thus a big angle would show the top to better advantage than the side, while a low angle would be more suitable if details on the side had to be shown clearly. Planes at right angles to the line of vision retain their true dimensions in the pictorial view, while it is better to make those lines parallel to the line of vision less than full size, to give a better conception of the proportions. In Fig. 3 circles are drawn on each of the sides by the use of diagonals, as shown, which assists in the drawing of ovals.

In isometric projection the angle of tilt is 30 degrees. There are no horizontal lines. Fig. 4

shows a cube drawn in isometric. All circles when drawn in isometric are elliptical. To draw the cube the 30-degree set-square should be placed against the T-square. If the sides of the cube are 2 in. long, then every line will be drawn 2 in. long, as all lines are drawn the actual size.

When sketches have to be made away from the shop, isometric projection is out of the question, and angles of tilt, in the case of oblique projection, will be decided approximately. One has to work then without instruments, and probably the sketch is required quickly, but, even when so favourably placed, clear sketches can be made. The examples of the cube do no more than indicate what is meant by pictorial representation, but they explain the principles as thoroughly as a machine detail.

In books on machine sketching very definite and detailed instructions are given for sketching parts correctly, and the apprentice is advised to study these. The main thing is to consider the aspect which shows the features that are of greatest importance, rather than to make a fetish of one form of sketching. A knowledge of sketching is so rare an acquisition, that the apprentice who has devoted time to its study, and can quickly and accurately make a clear sketch, places himself above his fellows.

Use of Explosives in Foundries.

MR. R. T. SLEE, in a Paper read before the Broken Hill Branch of the Australian Institution of Mining and Metallurgy, gave a short account of the experience gained with explosives at the Newcastle (N.S.W.) Steel Works of the Broken Hill Proprietary Company, Limited. The management had decided that as soon as No. 2 blast furnace—which is of an improved design—was ready to be put into commission, No. 1 blast furnace was to be dismantled and reconstructed to a similar design to No. 2 furnace. This reconstruction entailed the removal of the brick lining of the furnace shaft, and also the removal and disposal of the "salamander" and hearth-lining. The method of disposal depends upon the size and nature of the salamander, and in the case under review it was decided to bury it below the hearth of the furnace to be reconstructed. A passage-way was made in the concrete walls of the cast house, and the sand-filling of the cast house removed sufficiently to allow of the concrete foundations of the furnace being reached. This passage-way was extended until the hearth was encountered. The next operation was the removal of the hearth-lining below the salamander. The removal of the concrete was not difficult; holes were drilled with jackhammers, the holes charged with gelignite in the usual way, and the charges fired by ordinary fuse and detonators.

In order to salvage as many as possible of the two bottom rows of hearth blocks, which appeared to be in good condition, the next operation was to remove the concrete foundation below them. The same drills were used for boring, but the size of the bits was increased; every hole as drilled had a water hose placed in it in order to cool its walls and to prevent a premature explosion when charging. When ready to fire, each hose was removed and the charge pushed home; the charge was wrapped in a clay envelope.

While the excavation was proceeding the work of dropping the salamander was also put in hand, and this work called for the drilling of holes around the circumference; in all, 15 holes, each about 4 ft. deep, were drilled; these holes were chambered to receive larger charges of explosive. Before charging them, a strong protecting fence of railway sleepers enclosing the space between the top of the hearth jackets and the tuyere jackets was lashed into position. Each hole was then charged with eighteen plugs of gelignite, and the charges were exploded by current obtained from the power circuit. When the work of removing the débris was completed it was found that the salamander was free all round its circumference. A cement bed was prepared for its reception—the supporting props fired, and the mass dropped; all timber was then removed and the salamander concreted in position, forming a foundation for the new hearth-lining.

On another occasion the metallurgical staff desired to examine the interior of three forging ingots, which were the first ingots cast in the steel foundry using a cast-iron mould. It was desired to split the ingots longitudinally, and it was thought that explosives might be used to bring about this result. The first ingot was drilled with eleven 1¼-in. holes, placed 12 in. apart and 18-in. deep. A trial showed that charges fired for the purpose of chambering had very little effect, the chambered holes only taking from one to two plugs more than the untreated holes in order to give the same depth of charge. Ten holes were charged, the remaining hole being rejected on account of it having ended in slag. The ten holes took 65 plugs; the electric detonators were inserted, and each hole tamped to the collar with clay; the detonators were connected to the firing-wires in parallel. The firing wires were next connected to a two-pole switch connected with the power circuit; by closing the switch the holes were all fired simultaneously. The result was a thin crack the whole length of the ingot, but apparently only about 6 in. deep, as a close examination of the butt-end did not reveal a greater depth. The holes were again charged, using 85 plugs, and fired as before. This time the ingot was split completely in halves.

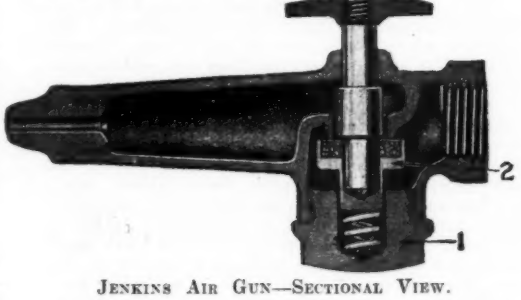
The second ingot was drilled in a similar manner, excepting that about six holes were drilled from the opposite side and arranged to pass between the holes on the other side. The same procedure was followed as in the first case, 85 plugs being used; a crack similar to the one in the first ingot was the result. Thirteen holes were then re-charged, using 65 plugs, and re-fired. The ingot was completely split.

In the third ingot the holes were placed 9 in. apart—27 holes in all, drilled from both sides, and charged with 120 plugs; they were then fired as before. The first explosion completely split the ingot, and also broke the two halves circumferentially.

Explosives were also successfully used at Newcastle for loosening the accretions formed on the bottoms of the open-hearth steel furnaces after a period of operation.

The Jenkins Air Gun.

This is the name of a nozzle with an air-valve of special design, placed on the market by Messrs. Jenkins Brothers, of New York, whose London representatives are at 6, Great Queen Street, Kingsway, W.C.2. The construction is very simple, as will be seen by the sectional view in our illustration. The nozzle and valve are made of high-grade steam bronze in ¼-in. size, and can be attached to hose-pipes of from ⅛-in. to ½-in. size by the use of suitable nipples.



JENKINS AIR GUN—SECTIONAL VIEW.

The "gun" can be used for many purposes. Thus, for instance, in the machine shop for blowing out chips, borings, filings, trimmings, for cleaning taps, dies, reamers, lathe and bench tools, milling machines, lathes, grinders, planers, etc. In the foundry it can be used for blowing off cores, cleaning core-boxes, flasks, patterns, and for general dusting. In forges, for tempering tools, and in numerous other places where air is used for cleaning, drying or cooling. When using the gun, the hose is connected with some compressed air supply, the gun is grasped firmly in the hand, and the button is pressed down. To remove the disc, the cap 1 is unscrewed and the disc-holder 2, along with the disc and spring, thus drop into the hand.

Production of Steel Castings.*

By F. Darley.

Scope of Steel Castings.

Forty years ago there were very few steel castings made, and these were only small, plain, and unimportant. To-day we find steel castings everywhere, in almost all shapes and sizes, weighing from a few pounds to upwards of 70 tons, doing service in the engineering world which before their advent was not possible, some of which are wonderful pieces of engineering skill, such as are required for structural parts of our large battle-

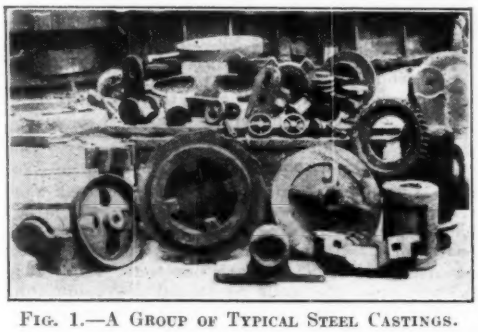


FIG. 1.—A GROUP OF TYPICAL STEEL CASTINGS.

ships, giant locomotives, and hydraulic presses, all of which are largely built up of steel castings.

To the inexperienced person it is not easy to realise how all these wonderful pieces are produced, but to the person who really interests himself in the methods of the production of steel castings the art is ever opening and showing new phases and possibilities of improvements.

Production Essentials.

The production of steel castings is essentially an art which can only be acquired by long experience, and involves a knowledge of so many little details which are of the greatest importance. The first stage in the production of anything must be in the hands of the designer, who should have some knowledge of the difficulties in making sound steel castings. Small and unimportant alterations in the design will often constitute the difference between a success and a failure. He puts his ideal on paper through the draughtsman, who works out the required strength, and then makes a working drawing for the pattern-maker to construct the patterns. The pattern-maker must be able to read and understand thoroughly the drawing. He must then consider which is the correct way to mould the job, whether it should be made from a striking board and core-boxes, or it may be a complete pattern or model of what the casting is required to be, or part pattern and part core-boxes, which means that the internal parts, and probably some of the external parts, are made in

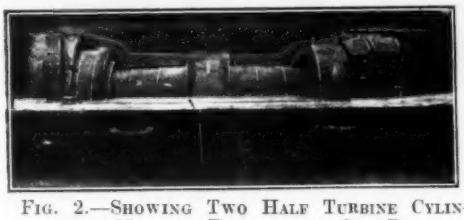


FIG. 2.—SHOWING TWO HALF TURBINE CYLINDERS MOULDED TOGETHER IN ONE BOX.

core-boxes of the required shape. Some of these boxes must be made with all the parts complete, others may be made as frames or skeleton boxes, strickled off to shape by means of shaped board. These cores must be the correct size and shape, so that they will fit into their proper positions, and with the pattern form a complete mould. Here is where the art of the pattern-maker is shown. After reading the drawing, he must be able to work accurately, also he must have some engineering knowledge to enable him to construct his pattern in a practical manner. He also must have a fair knowledge of moulding to enable him to decide how his pattern should be made to suit the moulders' requirements. If it should be a complicated and intricate job he should first consult the foreman moulder as to which he considers is the correct way to mould it to enable him to make a sound casting, which must depend very largely on the skill and experience of the foreman, seeing that he must decide which is the correct place from which to run it, also the proper position for his feeding heads, either of which, if in the wrong place, may mean a water casting. The writer firmly believes that a large number of castings are faulty through one of the above being in the wrong place.

Sand a Consideration.

Another consideration which is very important is the correct composition of sand to use, the ramming up or construction of the mould, which must be made sufficiently strong to withstand the strain of the fluid steel, and yet weak enough to collapse at the right moment, to allow the casting to contract during cooling, otherwise there is great danger of the casting pulling itself to pieces. Means of overcoming local strains due to contraction have to be anticipated and met, to obtain satisfactory results. It must be borne in mind that conditions vary with different classes and weight of castings. It will be seen, therefore,

FIG. 3.—THE CARCASE OF A BED PLATE MOULD.

that it is impossible to lay down any definite rules in the manufacture of steel castings, as each class of job must be taken on its own and left to the judgment of the foreman or man responsible. Another and the most important consideration of all is that we have metal of the correct composition and temperature, carefully melted and finished; otherwise, no matter how perfect and correct the mould and method of casting may be the castings will not be sound. A general survey of the subject cannot fail to be interesting, as very few people, even those who are accustomed to deal with steel work generally, have very little idea of the many difficulties which present themselves in the production of steel castings, especially where a large variety of work is dealt with, ranging from, say, a few pounds to 50 tons. Fig. 1, however, shows a group of small castings.

Amongst the larger castings are large spur and fly-wheels, ship stern frames, stems shaft brackets, rudders, turbine wheels, cylinders, nozzle boxes, steam valves, strainers, control and main steam valves, some of which are most complicated, and all classes of locomotive castings, some of which are works of art. The introduction of the steam turbine brought forward some very interesting and intricate work in the foundry trades.

* A Paper read before the Sheffield Branch of the Institution of British Foundrymen.

Turbine Wheels.

In the first instance the propellers were driven direct from the turbine shaft. The cylinders were then made in cast iron, moulded in loam, some as large as 12 ft. dia—the *Lusitania*, for instance. The rotor centre wheels were either cast or forged steel. Many difficulties presented themselves in producing these as steel castings.

Some years ago Messrs. Thos. Firth & Sons, Limited, received an order for some about 10 ft.

FIG. 4.—SHOWS THE SAME MOULD AS FIG. 3, BUT WITH CORES IN POSITION.

6 in. dia. by 2 ft. 6 in. on the face, with a very heavy boss, and arms cast in, weighing about 18 tons each. The first one was cast successfully, and after allowing it to cool sufficiently to be safe to handle it was taken from the mould while hot, and on account of this a large amount of sand adhered to the casting, which consequently went into the furnace with it. It was heated up to the required temperature, and maintained for several days to allow the heat to penetrate. It was then allowed to cool in the furnace until it was apparently cold, but after being in the shop for three days, and partly fettled, it flew to pieces. There were four wheels of this diameter to make, and this was the start. Therefore, after this first experience it was decided that it was not safe to cast a second on the same lines. What is considered a safe way with a wheel casting of large dimensions, especially with arms cast in, is to split the boss between alternate arms, and fill in the splits with soft metal, and hoop with forged steel hoops. The customers could not allow this in a turbine wheel, as they required them to be shrunk on the shaft. It was therefore suggested splitting the rim between alternate arms, which would have the same effect as splitting the boss, in allowing the arms to contract. The customers agreed to this suggestion, so the rim was split in three places, with cores 1⅜-in. thick, making provision for machining out the splits, and fitting in steel plates, bolting them together, thereby forming a complete rim, equal to a rim cast solid, with all the casting strains relieved.

The cooling of this casting presented much of interest. Some time after being cast, the top part of the mould was removed, and as the wheel cooled the splits began to open wider, until they measured from 2¼ in. to 2⅜ in., instead of the original 1⅜ in. arranged for. This was one of the most instructive examples one could have of the process and effect of contraction in large castings. The rim being the thinnest part of the casting would naturally cool first and contract the quickest, but being split was free to close in as the boss and arms cooled afterwards, until the splits came to be 1½ in. to 1⅝ in. instead of the original 1⅜ in. This slight difference would probably be caused by the resistance of the arm cores.

Considering now the strains a casting of this class must be subject to, if cast in a solid piece without splits. If it does not break the contraction would inevitably take place just in the same manner. Firstly, the rim would probably stretch so much, and would put a compression upon the arms, when the rim has practically finished contracting, the arms and boss continue to contract until they are quite cold, some time after the rim has reached this stage.

This uneven cooling sets up a very severe tension on the arms, so much that a very slight shock such as a blow from a hammer, or a bump, would cause one or more of the arms to break.

The success of the experiments with split arms became widely known, and within a few months following the principle was adopted by the Admiralty and all the leading marine engineers; in fact, it is not thought that anyone asked for a turbine wheel over 5 ft. dia. to be cast without being split in the rim within 12 months after the first one had been made.

Turbine Constructional Details.

The steam turbine to be efficient must be run at high speed, which is not satisfactory for the screw propeller. The most efficient speed for the screw propeller is below 200 revs. per min. This was the reason the turbine cylinders in the past were built so large to get high power at a moderate speed. But of late years this has been revolutionised by the introduction of the geared turbine, which instead of driving the propeller direct from the turbine shaft, as was the custom when the turbine was first introduced for marine work, it is driven by means of a small pinion on the turbine shaft into a wheel four to ten times the dia. on the propeller shaft, and in some cases there are two sets of reduction gear thereby reducing the speed of the propeller to the most efficient and correct speed.

Turbine Cylinders.

This system has completely revolutionised the marine turbine, doing away completely with large diameters, and introducing high pressure, high speed, and small diameter turbines, which means that large centre wheels are no longer required; the small ones are made as forged discs, but, on the other hand, on account of cast iron not being satisfactory for high-pressure superheated steam, the high-pressure turbine cylinders, steam valves, and nozzle boxes are now called for as steel castings, which requires the highest skill in the art of pattern-making and moulding. Two patterns and 16 core-boxes are required. In this job there are so many complicated cores, ports, branches, webs, feet facings, and uneven thicknesses which appear to make it almost impossible to make a sound casting. Here is a problem: first, how to mould the job, how and where to run it, and how to feed it so as to make it sound. This is an important and difficult point, and requires some serious thought, and is generally overcome by reducing some of the thick parts where practical, or by adding feeders alongside the thin places in order to reach the thick parts which require to be fed. This must be very carefully considered or it will cause the casting to pull on account of uneven cooling. Fig. 2 shows the mould of two half-small turbine cylinders moulded together in one box, which in this case is done for convenience, having a moulding box at liberty suitable for two castings. These cylinders are moulded from two full patterns and are made joint, or flange down, to enable the moulder

FIG. 5.—THE BED PLATE MOULD WEIGHTED DOWN READY FOR CASTING.

to fix the cores, which form the internal parts, the outside being moulded by means of separate parts or drawbacks. These are all moulded on to the pattern, being built up by bricks and sand supported by cast-iron grids, all jointed in such a position as to enable the pattern with all the various branches, ribs, feet, bosses, and other projections to be removed. In this mould there are 16 loose parts or drawbacks and over 30 internal cores. After the outside mould is built up and the top part, which holds the whole lot together, moulded, every part is carefully marked and numbered and then taken to pieces to be finished and dried. The pattern is now withdrawn and the mould dried, when all the parts are gathered together ready to be assembled. The

cores which form the inside parts are first placed in their correct positions, and secured so that the flow of metal will not displace them, after which the drawbacks, which form the outside of the mould, are fixed and secured in their respective positions. As the moving of a core or drawback may mean a waster of a very expensive casting, last of all the top part is placed in position and securely clamped ready for casting.

Large Diameter Cylinders.

When these cylinders are required in large diameters some difficulty is often experienced in keeping them in the correct shape. It is found that on machining, some of them have not contracted across the joint, and are ¾ in. too wide, and will not machine up in the bore, the difficulty being now to bring them in, so that the bore would machine up. They are very strong on account of having one end cast in, also various ribs and feet cast on. In an instance encountered by the writer, first local heating was tried, and then screw rods, etc., but it would not move, therefore, it was decided to let the annealing furnace do the job. Three strong clamps were obtained and fixed across the wide part along the joint and wedged on. The casting was then placed with the clamps down in the furnace, the clamps being buried with sand and fire-bricks, so that the heat could not get to them and expand them. The casting being exposed to the heat of the furnace was bound to expand, but being held by the cramps at the joint flange caused the casting to close in and bring it into its proper shape. This treatment proving a success, it has been adopted on several occasions with equally successful results.

A large rotor spider centre is moulded by means of a striking board and core-boxes. The bottom part is struck up from a centre spindle and striking board while the outside of the mould is formed by large segment cores fixed together, true, by the centre spindle and board. After they are all fixed, the centre spindle is removed and the centre core fixed, after which the outside is rammed up with old sand to hold the mould in position sufficiently strong to withstand the strain of the molten metal. The top part is now fixed and secured fast to the mould, which is then cast. It must then remain in the mould at least 5 or 6 days so that it may cool evenly. It is then taken into the fettling shop and the sand removed, the head parted off, and, after fettling, annealed.

Making Large Base Plate.

Fig. 3 shows the outside portion of a mould for a large base plate for a 2,000-tons' press. This mould is formed without a pattern by means of cores made in special core-boxes. First a pit is prepared in the foundry floor sufficiently deep to bury the job. A suitable foundation, by means of a coke bed, is carefully prepared and covered with several inches of sand rammed down firmly and strickled off level. It is then dried by coke fires, cleaned, and centre lines set out at right angles, from which the shape of the mould is marked. The cores are then fixed to the marks in their correct position, one by one, until the complete outside of the mould is formed. Temporary stays or props are fixed inside, so that the outside walls of the cores can be rammed up firmly and hard, so that it will stand the strain of the molten metal when cast. When the outside is made secure the temporary stays are removed, and the inside cores are fixed. These form the holes for the columns, and the thickness of metal ready for the top part, which is now fixed, as is shown in Fig. 4. The securing of this is very important on account of the tremendous lift or strain there is on this caused by the liquid pressure from the feeding heads being so much higher than the level of the casting. This requires the equal to about 100 tons deadweight to hold down the top part. The fixing of this is an engineering job, and is illustrated in Fig. 5. The weights are fixed on steel girders placed across the top of the mould, which must be so packed that there is no weight actually on the top part or there would be a danger of crushing the mould. The top part is then packed tightly underneath the girders, but evenly distributed so as not to crush the mould, which would mean a waster casting. It is now ready for casting. It is then cast from two runners to enable it to run up quickly. It should then be left in the mould until it is cold, which will be about two weeks, after which it is lifted from the mould and taken into the fettling shop. Here all the inside cores should be removed first, so that the air can get through and allow it to cool thoroughly, after which the sand is cleaned off and the heads parted off by means of a cold circular-saw. The casting, shown in Fig. 6, is now ready for annealing. It is put into the furnace and heated up gradually to 850 deg. C., the heat being maintained for about 24 hours to allow the temperature to be even throughout when the casting-structure should be thoroughly broken down. It should then be allowed to cool down in the furnace with the doors closed. It is now taken out of the furnace and finished ready for delivery.

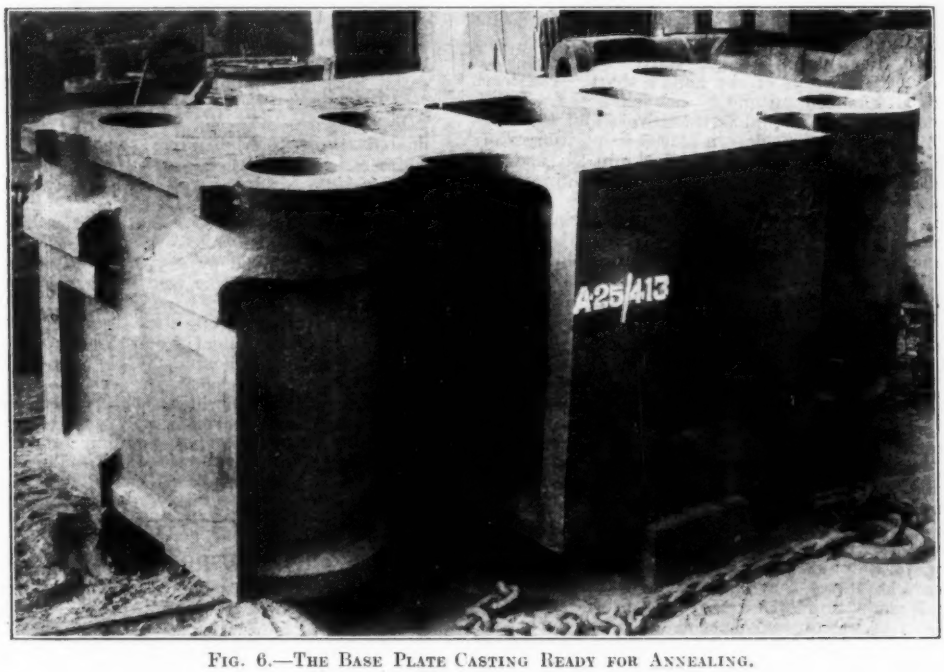


FIG. 6.—THE BASE PLATE CASTING READY FOR ANNEALING.

Moulding a Spur-Wheel.

In Fig. 7 is illustrated a large double helical spur rim, for use in a rolling mill, being moulded in the floor. First, a pit is prepared

about the depth of the casting, and a sound foundation made, properly vented by means of cinders or other porous material. A sand face is then rammed up and struck to the correct shape by means of a striking board, worked on a centre spindle; next the outside of the mould is built up with bricks and slurry, not mortar. The wheel-moulding machine is now placed in the centre of the mould, the arm bolted to the table which carries the slide on which the tooth block is fixed, and held in position in the mould until the tooth is rammed, after which the block is withdrawn. The machine is then moved round the exact fraction

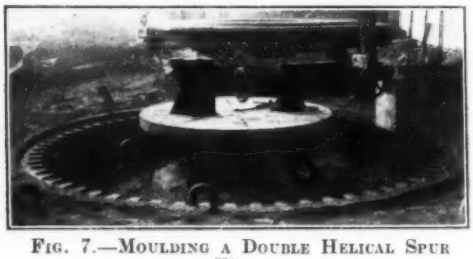


FIG. 7.—MOULDING A DOUBLE HELICAL SPUR WHEEL.

of a circumference required for the correct number of teeth. This is done mechanically by means of change wheels, similarly to a screw-cutting lathe, worked out to get the correct movement by so many turns of the handle shaft. The teeth are all rammed up one by one until the wheel is complete. The mould is then dried and the cores which form the inside are placed in position ready for the top part, which is then put on and the job cast. It must be allowed to remain in the sand until cold, after which it is lifted, fettled, the heads parted off, annealed and finished ready for delivery. This rim was ¾ in. oval after it came out of the annealing furnace, but it was tuned up to within ⅛th of an inch before delivering.

(To be continued.)

Sulphur from Blast-Furnace Slag.

In a recent article in "Stahl und Eisen," PROFESSOR L. H. DIEHL, of Oberhausen, describes and discusses his process for the recovery of sulphur from blast-furnace slag. After referring to the importance of sulphur in modern industry, and to the fact that before the war about 1,000,000 tons of pyrites, 250,000 tons of blende and 30,000 tons of sulphur were imported into Germany each year, he states that during the war every effort was made to increase the output of German deposits of pyrites and zinc blende, and efforts were made to obtain sulphur from the large beds of gypsum and anhydrite (natural anhydrous calcium sulphate). Unfortunately, efforts in these directions have not been entirely successful, and there is to-day a scarcity of sulphur in Germany. It was therefore desirable to investigate every available source of sulphur, which led the author to work on blast-furnace slag. Even if its sulphur content is small, the total amount is very large.

The slag production in Germany before the war was about 20,000,000 tons, with sulphur running from 1 to 2.25 per cent. and averaging 1.50 per cent. This represents at least 300,000 tons of sulphur thrown away each year. Because of this large available supply, efforts were made to develop a process for its recovery.

The Diehl process consists in obtaining sulphuric acid by oxidation of the calcium sulphide in blast-furnace slag by air or by sulphates such as gypsum or anhydrite, with the help of air. The chemical reactions are:—The calcium sulphide unites with oxygen and gives lime, which changes to orthosilicate, and at the same time free sulphur is liberated. With sufficient excess of air, this is burned and, if not, it passes off unburned with the gases.

Because of the low sulphur content of blast-furnace slag, which precludes remelting or subsequent treatment, all the work was done on the molten slag as it came from the furnace by blowing air through it. Preliminary tests carried out with molten slag and oxygen gave a gas containing 23.1 per cent. SO_2 by volume. Further experiments showed that slot-shaped tuyere gave a richer gas than a round one. Following these tests an apparatus was designed that has been used successfully for several months at Gutehoffnungshütte. When the apparatus is warm and the slag hot and fluid, the pressure is from about 2 to 3½ lbs. per sq. in., but often rises to about 4½ lbs. if the slag is colder, due to the formation of a spongy solid slag above the tuyeres.

At the end of a run of slag, the tapping hole is opened and the slag drained off. The working door is opened next, and the crusts and scales around the tuyeres broken and removed. The slag coating on the apparatus itself is allowed to remain unless it breaks off automatically, as it protects the metal against sudden changes of temperature, and also serves as an insulator for the slag, preventing unnecessary cooling.

The sulphur output is higher as the slag is hotter and higher in sulphur. Acid slags give off sulphur more easily and more thoroughly than do strongly basic slags. However, the latter are usually hotter and higher in sulphur, so that good results are obtained.

The change in appearance of the slags after treatment is interesting. Slags with large amounts of calcium sulphide are milky because of numerous needles of sulphide. Such slags, after treatment, become completely clear and glassy, a proof that the sulphide is decomposed and the lime dissolved in the body of the slag. In some cases, with high-sulphur slags and insufficient air, free sulphur is produced.

If the gases produced in the process are conducted through iron pipes, an incrustation of white salts is produced, consisting almost entirely of potassium bisulphate. The temperature of the gases is about 930 deg. to 950 deg. C., measured away from the range of radiation from the fluid slag.

The gases obtained by the Diehl process contain on the average 6 to 7 per cent. SO_2, small amounts of CO_2 (from 1 to 1.2 per cent.), and about 10 per cent. oxygen, while the rest is nitrogen. There is entire freedom from arsenic, chlorine, fluorine, carbon monoxide, sulphur and dust or similar impurities, except for small amounts of potassium bisulphate, which can be easily removed. The gas is therefore remarkably suitable for the production of specially pure sulphur products. A very rich gas can be obtained if a sulphate such as calcium sulphate is added to the slag while air is blown in.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Semi-Steel.

To the Editor of THE FOUNDRY TRADE JOURNAL

SIR,—As a practical man, the methods I recently employed when manufacturing a 4-ton cast of semi-steel may be of interest for your readers.

Considering that a good temperature is essential, I first ran through 4 tons of grey iron. This, of course, provided a good hot cupola. Then 2 tons of 20 per cent. semi-steel was put through, followed by a further 2 tons of 10 per cent. material. The casts were handled by four 12-cwt. bogie ladles. Though the weight of the castings ranged from a few lbs. up to 2 cwts., there would not have been the slightest difficulty in making a 5-ton casting, as the metal came down as quickly as it could be handled, and at a white heat. Under such conditions it does no harm to allow the cast to stand for a short time, but obviously it must be done with discretion. The cupola used is 52-in. dia. and provided with eight tuyeres. The semi-steel was all poured within 20 mins. and the moulds all cast up within 30 mins.—Yours, etc.,

J. MC. E.

Mr. J. Longden, who has been acting as assistant secretary to the London Branch of the Institution of British Foundrymen has been appointed Foundry Superintendent to Messrs. D. and J. Tullis, Limited, Kilbowie Ironworks, Clydebank, Glasgow.

Company News.

Pinchin, Johnson & Company, Limited.—Interim ordinary dividend, 5 per cent. actual.

United Steel Companies, Limited.—Payment of half-yearly dividend on cumulative preference shares postponed.

Dalmellington Iron Company, Limited.—Final ordinary dividend, 6d. per share, free of tax, making 5 per cent. for the year.

James Brookes (Birmingham), Limited, 343, Bradford Street, Birmingham.—Capital £8,000, in £1 shares. Ironmasters.

Short Bros., Limited, Pallion, Durham.—Capital £300,000, in £10 shares (15,000 preference and 15,000 ordinary). Shipbuilders.

Scottish Iron & Steel Company, Limited.—Dividend, 6 per cent. per annum, less tax, for half-year, on 6 per cent. cumulative preference shares.

Lorimer Brothers, Limited, 20, Dixon Street, Glasgow.—Capital £3,000. Engineers, etc. Directors: J. A., Wm. R. D., and J. Lorimer.

E. C. Ogden & Company, Limited, 4, Clerkenwell Green, London, E.C.—Capital £5,500 in £1 shares. Engineers. Directors: E. C. Ogden and L. W. Ogden.

Gibson Brothers (Hebden Bridge), Limited, Osborne Works, Hebden Bridge, Yorks.—Capital £2,000 in £1 shares. Engineers. Directors: S. Gibson and J. R. Ashworth.

D. J. MacDonald, Limited, South Street, Roques, Dundee.—Capital £50,000. Engineers, etc. Directors: D. J. MacDonald, W. R. MacDonald, and Miss M. Y. MacDonald.

L. Withers Green, Limited, 110, Victoria Street, London, S.W.—Capital £3,000, in £1 shares. Engineers. Directors: G. E. Brine, L. Withers Green, R. A. Robertson, and C. T. Witt.

Dunn & Company, Cheltenham, Limited, 21, Bath Street, Cheltenham, Glos.—Capital £2,000. Electrical and general engineers. Permanent directors: W. E. Thomson and A. E. Dunn.

Sharpe & Peterson, Limited, 28, Royal Exchange Square, Glasgow.—Capital £1,000. Designing, mechanical, structural and general engineers, etc. Directors: D. Sharpe and D. C. Paterson.

Monk Bridge Iron & Steel Company, Limited.—Brought forward, £43,597; loss, after adjusting taxation and providing for bank interest, etc., £17,621; available, £25,976; dividend on cumulative 6 per cent. preference paid; carry forward, £10,976.

Blands, Limited, South Knighton Garage, Knighton Church Road, Leicester.—Capital £4,000 in £1 shares (2,500 7 per cent. cumulative preference and 1,500 ordinary). General engineers, etc. Directors: E. Bland (permanent governing director) and H. W. Bland.

R. H. Piggford & Company, Limited, 21, Telegraph Buildings, Sheffield.—Capital £7,000, in £1 shares, to take over the business carried on as "R. H. Piggford & Company," of engineers, manufacturers of oxy-acetylene and other welding plant, etc. Permanent directors: R. H. Piggford and G. N. A. Pitt.

Personal.

THE LATE MR. F. MOSES WINTER, Abbeyfield Road, Sheffield, a director of Ibbotson Brothers and Company, Limited, left £1,979.

MR. C. T. BARLOW has resigned his seat on the board of Accles & Pollock, Limited, weldless steel tube manufacturers, of Oldbury.

MR. W. HUNTER, for many years head of Hunter, Hardin & Wilson, Glasgow, who died on March 9, left personal estate valued at £27,539.

MR. A. W. MAYCOCK has been appointed manager of the machine, tool, etc., department of Martin Bros. (Machinery), Limited, of Bridge Street, Manchester.

THE LATE MR. ALEXANDER SIMPSON, J.P., of St. Elmo, Craighall Road, Leith, Edinburgh, a director of Redpath, Brown & Company, Limited, left personal estate valued at £28,747.

ENGINEER VICE-ADMIRAL SIR GEORGE GOODWIN, late Engineer-in-Chief of the Fleet, and Dr. James Colquohonn Irvine, Vice-Chancellor and Principal of St. Andrew's University, have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

Japan to Make Tinplate.—The Imperial Steel Works at Yawata, Japan, has completed construction of its plant for making tinplate. This plant was erected with a view to checking imports of tinplate from America. Its estimated annual capacity is 20,000 tons, although the first year's production is not expected to exceed 6,000 tons.

Contracts Open.

Dundee.—Supply of 30 malleable iron seats, for the Town Council. Mr. J. Thomson, city engineer, 91, Commercial Street, Dundee.

Johannesburg, September 27.—Supply and delivery of 1,475 brass cocks, for the Johannesburg Municipal Council. The Department of Overseas Trade (Room 49), 35, Old Queen Street, Westminster, S.W.1.

Swansea, September 8.—Supply and delivery of the following, for the Swansea Town Council, viz.:—(1) Cast-iron pipes and specials; (2) waterworks appliances, including valves, hydrants, etc.; (3) water meters. The Water Engineer and Manager, Guildhall, Swansea.

Swansea, September 8.—Stores, ironwork, etc., for three or six months from October 1, for the Town Council. The Borough Engineer and Surveyor, Guildhall, Swansea.

Nantwich, September 22.—Supply of the following, for the Nantwich Rural District Council:—(Contract No. 1) cast-iron water pipes, branches, and other pieces; (2) hydrants, sluice valves, fittings, etc. Mr. H. Crabtree, engineer, 1, Dysart Buildings, Nantwich. (Fee 10s., returnable.)

Ruskington, Lincs., September 18.—Supply, laying and jointing of about 2¾ miles of 2-in. diameter cast-iron main, irregulars, valves, and other works of water supply, for the Ruskington Urban District Council. Mr. S. F. Clare, engineer to the Council, Sleaford. (Fee £1 1s., returnable.)

Gazette.

MESSRS. J. HARGREAVES, JUNR., J. Hargreaves, Senr., and R. Boulger, pattern makers, 7, Charles Street, Manchester, trading under the style of the City Pattern Company, have dissolved partnership.

A PETITION for the winding-up of Fuller's United Electric Works, Limited, was presented on August 18 by W. S. Caines, Limited, of Andover House, The Broadway, Plaistow, creditors of the company. The petition is to be heard in London on October 17.

THE partnership heretofore subsisting between Jane Lamb, Ellen Douthwaite, William George Merriman and the late Hartley French, carrying on business as chain and anchor merchants, at the Mill Dam, South Shields, under the style of G. Lamb & Son, has been dissolved. Mr. William George Merriman will continue to trade alone under the style of G. Lamb & Son.

AT the expiration of three months the names of the undermentioned companies will be struck off the Register of Joint Stock Companies, and the companies will be dissolved:—Aeronautical Engineering Company, Limited; Aero Sheet Metal & Engineering Works, Limited; Anderson's Shipbuilding & Repairing Company, Limited; Brooks Motor & Engineering Works, Limited; Clutchnut Engineering Company, Limited; Engineering and Aircraft Construction Company, Limited; Expert Metal Workers, Limited; Gerrard Engineering Works, Limited; Ingate Engineering Company, Limited; International Electrical & Mechanical Supplies Company, Limited; Lattimer Engineering Company, Limited; Lubros Engineering Company, Limited; Ostroyd Engineering Company, Limited; Pressure Casting Company, Limited; Slough Metal Company, Limited; Southern Shipbuilding & Engineering Company, Limited; T. W. Field Engineering Company, Limited; United Electrical Works, Limited; Warstone Engineering Company, Limited; West Ham Engineering Company, Limited.

The Institution of British Foundrymen,

At a General Council Meeting, held at the Midland Hotel, Manchester, on September 2, the following were accepted for membership:—

The Staveley Coal & Iron Company, Limited (Lancs.).
John N. Bentley (W.R. of Y.).
Albert H. Lewis (Lancs.).
Chas. P. Markham (Lancs.).
Jerry Stones (Gen.).
John Pinder (London).
Robert Pinder (London).
John Boyle (W.R. of Y.).

The following were elected Associate Members:—
W. Hird (W.R. of Y.).
Charles A. Howe (Gen.).
Arthur Phillips (Lancs.).
James Houghton (Coventry).
Joseph Hibbert (London).
Thomas Hull (W.R. of Y.).

Trade Talk.

SMITH'S DOCK COMPANY, LIMITED, have booked orders for six powerful tugs and two trawlers.

THE IMPORTS of foreign iron ore at the Lonsdale Dock at Workington last week amounted to 1,365 tons.

H. INCLEDON & COMPANY, LIMITED, tube manufacturers, are establishing a branch at 18, Ludgate Hill, Birmingham.

WALLIS-JONES & DENT, consulting engineers, have removed to 50, Queen Anne's Gate, Westminster, London, S.W.1.

THE JEARY ELECTRICAL COMPANY, LIMITED, 8, Lambeth Hill, London, E.C.4, are establishing a branch at 97, Queen Victoria Street.

THE INCORPORATED MUNICIPAL ELECTRICAL ASSOCIATION is arranging for a municipal visit to Paris to inspect the generating station.

MISS C. GRIFF, who is chairman of the Women's Engineering Society, has established the Stainless & Non-corrosive Metal Company, 14, Weaman Street, Birmingham.

THE members of the Manchester branch of the Institution of Locomotive Engineers will visit the Dukinfield Carriage and Wagon Works of the Great Central Railway on September 13.

PALMERS SHIPBUILDING & IRON COMPANY, LIMITED, Hebburn, have received an order to carry out extensive alterations and repairs to the steamer "Ascanius," owned by Alfred Holt & Company, of Liverpool.

TENDERS for the building of the new floating dock at Southampton to the order of the London & South Western Railway Company have been invited, and must be in the hands of the company by September 6 next.

COCHRANE & SONS, LIMITED, of the Ouse Shipbuilding Yard at Selby, have recently launched from their premises two steel lighters which have been made to the order of the Grimsby Coke, Tar and Coaling Company.

THE directors of the Leeds Forge Company, Limited, state that owing to depression in trade, and the loss caused through the engineers' strike, it is not proposed to pay the usual interim dividend on the preference shares.

THE members of the Newcastle and District Branch of the Institution of British Foundrymen held a meeting on Saturday last, at the Neville Hall, Newcastle-on-Tyne, when a lecture was given by Mr. D. McLain, of Milwaukee, U.S.A., on "Semi Steel and Cupola Practice."

THE GLASGOW CORPORATION have decided by a very small majority to accept the American tender for tramway rails. It may be remembered that the United States concern quoted a figure amounting to £15,325, and that an English firm was second lowest with £18,262, while others ranged up to £18,600.

AT the meeting of the shareholders of the Tata Iron & Steel Company, Limited, the directors accepted a suggestion that there should be a dividend paid on the ordinary shares, and they fixed the dividend at a rate of 4 per cent per annum. Previously they had recommended that no dividend should be paid on the ordinary shares.

A BALLOT is now being taken among workers in the iron and steel trades to decide whether the sliding scale agreement of July, 1921, for the regulation of wages shall be cancelled or not. The votes are returnable on September 26. The societies concerned are the General Workers' Union and the National Amalgamated Union of Labour and others.

A CONFERENCE will be held on September 12 at Edinburgh between representatives of the Shipbuilding Employers' Federation and the Executive Committee of the Federation of Engineering and Shipbuilding Trades. At this conference the employers will propose that the remaining 10s. of the war bonus of 26s. 6d., paid in abnormal circumstances, shall be discontinued, and that wages thereafter be stabilised.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to W. J. J. Lowther, 146A, Queen Victoria Street, London, E.C.4; Ed. Plummer, 29, Mirador Crescent, Swansea; Russell, Marshall & Company, Limited, 9, St. Thomas Street, London Bridge, London, S.E.1.; H. B. Sparrow, 65, Fenchurch Street, London, E.C.3; and Watts & Nephew, Limited, Allcock Street, Metal Works, Birmingham.

RENTON & FISHER, Hopetoun Works, Bathgate, Scotland, have ordered from the Volta Manufacturing Company, Limited, of Welland, Ontario, Canada, a three-ton "Volta" electric furnace, which they propose to erect at their works. The Volta Manufacturing Company are represented in Great Britain by T. Rowlands & Company, Limited, 23-27, Broomhall Street, Sheffield, and the furnace which Messrs. Renton & Fisher are installing is the first of this make to be erected in Great Britain.

THE ANDERSON GRICE COMPANY, LIMITED, of Carnoustie, have secured an order from the Abertillery and District Water Board for two electric loco cranes, for service in the construction of the Gryne Fawr Reservoir. These cranes will be of the 3-motor type, and will have an effective radius of 40 ft. and a lifting capacity of two tons. The motors are being supplied by J. P. Hall & Company, of Oldham, and the control equipment is of British Thomson-Houston manufacture. There was keen competition for the order from abroad.

THE RETURNS from the Clyde shipyards in August show that fourteen vessels, aggregating 53,123 tons, have been launched. This is the largest monthly output this year. For the same period last year the tonnage was 34,665. The most notable vessels launched have been a motor vessel for the Royal Mail Steam Packet Company and a geared turbine steamer for a French shipping firm, both of 9,000 tons gross. The only new contracts reported are two cable steamers by John Brown & Company, Limited, two cargo steamers by the Charles Connell Company, and a British India vessel by Barclay, Curle & Company, Limited.

THE BOARD OF TRADE have now received the reports of the Committee, appointed under the Chairmanship of Sir Charles Stewart, to inquire into three separate complaints under Part II. of the Safeguarding of Industries Act, relating to wire nails manufactured in Germany, snap fasteners manufactured in Germany and Czecho-Slovakia, and hooks and eyes manufactured in Germany. The reports, which will be published and presented to Parliament, are not to the effect that the conditions laid down in Section 2 (1) of the Act are fulfilled. Consequently, in view of the provisions of Section 2 (3) of the Act, the Board of Trade are unable to take any further action in respect of the complaints in question.

IT IS NOW ANNOUNCED that no agreement has been reached between Lithgows, Limited, shipbuilders, of Port Glasgow, and the Boilermakers' Society regarding the construction of ships at pre-war or other special rates of wages. The vessel on which work has been started is a small steamer contracted for in the ordinary way of business, and not one of the four which the firm proposed to lay down under their special scheme. It is added that the men are still opposed to accepting pre-war rates, that their Society has asked the shipbuilders for a conference to consider the whole question of price list payments, and that until this conference is held nothing will be done regarding starting work on the proposed relief ships.

THE GENERAL SLACKNESS of trade was dealt with by Mr. A. F. Nicol, who presided at the meeting of the Chesterfield Tube Company, Limited, in London last week. He said that when they met last year he had expressed the hope that they would see a return of stable and bright conditions, both with labour and with trading. In the labour sphere those hopes had been to some extent realised, but from the important standpoint of general business, on which their own well-being and also the actual employment of labour depended, their hopes had not fructified at all—quite the reverse. There never had been so disappointing a time to many old-established manufacturing trades as the year which had just gone by. It had not been a question of good or bad management, or of well or indifferently equipped works. Neither management nor equipment could have altered the fact that in most lines of trade the volume of demand had been deplorably short of normal.

Wabana Ore for Nova Scotia.—We stated in "Canadian Notes" on June 30 last that under an agreement between the British Empire Steel Corporation and the Newfoundland Government the 25-cent. royalty is to continue in force until December, 1940, but in the event of failure on the part of the Corporation to carry out its agreement, an export tax of $1 per ton will be imposed by the Newfoundland Government upon all ore mined and shipped abroad, except to the Canadian Province of Nova Scotia. According to a statement in a Canadian paper by Mr. R. M. Wolvin, President of the British Empire Steel Corporation, the agreement with the Newfoundland Government (as quoted in the volume on the iron ore of British America recently issued by the Imperial Mineral Resources Bureau), includes the following provisions:—(1) All ore shipped to Nova Scotia shall pay an export tax of 25 cents per ton. If the annual shipment to Nova Scotia is a million tons or over, ore may be shipped to other points in Canada without tax; if less than a million tons, the tax of 25 cents shall be paid up to a million tons. (2) Ore may be shipped free of tax to countries other than Canada, provided the company spend three million dollars during the next five years on improvements and developments in their plants, and that they give notice before January 1, 1926, of their intention to erect in Newfoundland a smelting plant of 100,000 tons annual capacity, else a tax of 10 cents per ton will be levied on such ore.

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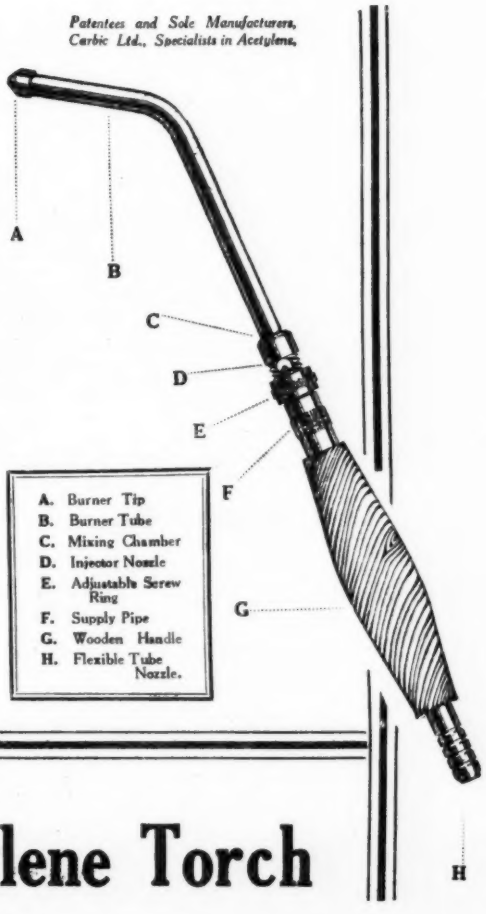

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IRON AND STEEL MARKETS.

Pig-iron.

Only slow, if steady, movement towards return to normal conditions can as yet be recorded as concerns pig-iron markets, in which, however, a distinctly better feeling is expressed now that active business has recommenced after the holidays. Among the more promising signs pointing in this direction are the re-opening of iron-ore mines in several localities, and an increase in the volume of inquiries, slight, perhaps, on home consumers' account, but substantially augmented by American demands, due to current labour difficulties, which are hampering blast-furnace production in the States. Competition in the home markets is also growing more active, Midland producers of pig-iron now pressing sales in Scotland, formerly almost entirely monopolised by the Cleveland makers, aided largely by the seaboard facilities for transport to Clyde-side. Another factor in the present position is the slackness at the foundries, work in this industry being extremely irregular, some branches being fairly well off for orders, while others supplying principally the engineering firms are only partially employed, the Lancashire districts reporting that most makers of iron castings are operating on an average about two days per week. In the Manchester market, at one time an important buying centre for Scotch pig, the high prices now demanded for that quality iron are almost prohibitive, and in consequence foundrymen are now turning attention to North-East Coast hematite, which can be bought almost as cheaply as Cleveland No. 3 G.M.B. On Tees-side, business was practically suspended last week, owing to the annual festival at Stockton Races, and market movements were therefore confined within very narrow limits. Demand on Continental account has been on a restricted scale, owing to the demoralisation of European exchanges, but it is satisfactory to note that last week a cargo of iron was despatched to Czecho-Slovakia, quite a new departure in the Tees-side export trade. At the moment, however, the American demand is the dominant feature of the Cleveland trade. How long this movement will continue it is impossible to say, but in all probability it will prove to be merely temporary, and it is due mainly to the needs of consumers near the Atlantic seaboard, whose supplies from inland have been stopped by the interruption of the rail haul. Last week, further large cargoes of foundry iron to a special analysis have been shipped, while more inquiries are now coming to hand for the ordinary standard quality, some substantial lots of which have already been sold. These sales to the United States have had the effect of reducing stocks, but so far they have not offered a sufficient inducement to makers to put in more furnaces. But prices have naturally shown a rather firmer tendency, and No. 3 G.M.B. is strong at 87s. 6d. per ton. The scarcity of No. 1 and silicious iron keeps the price steady at the high figure of 95s., No. 4 foundry is now nearer 86s. than 85s., with No. 4 forge at 84s., and mottled and white 80s. At Middlesbrough, business in hematite is rather better, but still inclined to irregularity. Home inquiry shows some improvement, but the export trade is very quiet, although a few parcels have gone to Italy, notwithstanding the depreciation of the lire. East Coast mixed numbers can be bought without difficulty at 89s. per ton, both for home and export, and even this figure can be shaded against firm offers. Hence there is barely a margin of 1s. 6d. between Cleveland No. 3 and hematite, a position which is practically unprecedented in the history of the trade. West Coast hematite shows some slight acceleration of activity, shipments being on an improved scale, although the home demand is still quiet. Prices are unchanged, with Bessemer mixed numbers quoted at £5 5s. per ton delivered Glasgow or Sheffield.

Finished Iron.

The lethargy so long prevailing in the markets for finished material has only been moderately relieved during the past month, nor is it considered probable that any really practical improvement will eventuate until the present quarter is ended. Buyers continue to hold off markets in the somewhat fallacious hope of an early substantial reduction in current quotations, which manufacturers declare quite out of the question while costs of production remain at present levels, and consequently specifications are only placed for immediate requirements. Yorkshire makers of bar iron report conditions unchanged, the demand not having improved to any substantial extent, and it looks as though it may be some time before business becomes more active. Swedish bar iron for the crucible trade is quoted here at about £17 5s. per ton, with not much doing. In South Staffordshire, work in the finished iron branches has been resumed, but there is very little change in the general conditions. The demand for nut and bolt iron is not so active as it was, but makers still have a few unexecuted orders on their books under which deliveries are being taken steadily, and they are hopeful that as these are worked off new ones will be forthcoming. In the meantime the quotation is maintained at £9 17s. 6d. There is still some movement in fencing bars at £10 to £10 2s. 6d., although here also buying is somewhat slower. For better qualities of bar iron demand is erratic, and the prices quoted are still very wide, much wider than used to be the case. Normally there should always be some range of quotations for the better qualities of unmarked bars, owing to the corresponding range in quality, but the present variation is most exceptional. Rather more business has been passing of late in gas strip. There is nothing fresh to report concerning marked iron, makers of known brands enjoying a fairly steady flow of specifications, though the majority would unquestionably favour a fuller volume of forward orders to ensure regularity of working.

Steel.

Business in most sections of the steel industry bears a rather more hopeful appearance, an exception having to be made in the case of high-speed qualities, which continue depressed, especially as concerns the American market, where the passing of the new Tariff Bill has had an adverse influence on one, if not the only outlet for the world-famous brands of high-speed metal, of Sheffield manufacture. There is some business in the cheaper steels, and overseas buyers, realising that prices are unlikely to go much lower, are placing contracts with more freedom. There is a fair amount of buying of railway and motor-car steel, but there is still plenty of room for improvement.

Scrap.

Reports from the various markets for scrap metal indicate a somewhat better outlook, although buying at the moment is chiefly confined to consumers' more urgent requirements. Prices on the whole are steadily maintained, and at Middlesbrough rule at about the following figures:—Heavy steel scrap, 65s.; steel turnings and c.i. borings, 47s. 6d. to 50s.; cast-iron machinery scrap, in handy pieces, 67s. 6d.; heavy wrought-iron ordinary piling quality, 60s.; ditto, good heavy forge of special quality, 70s. to 75s. per ton; all delivered works.

MACHINERY

(*continued from page* 24).

FOR SALE.—One No. 6 Thwaites Rapid Cupola, with drop bottom, complete with charging and cleaning doors in new condition, equal in every respect to new.—Price, £125, f.o.r., Keighley.

Two No. 6 Keith Blackman High Pressure Motor-driven Fans, complete with starters, etc, suitable for 400 volts, 50 periods, 65 amps., 12-in. delivery, 3-phase A.C.—Price, £125 each, f.o.r., Keighley.—Apply, Box 246, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, Strand, London, W.C.2.

CUPOLAS! CUPOLAS!! CUPOLAS!!!—Fifteen Riveted Steel Cylinders, as new, 18 ft. x 2 ft. 6 in.; would make excellent Cupolas, complete with Steel Girder Framework Pipes and Air Ducts; £300 the lot, f.o.r. Details, Drawings.—HARRY H. GARDAM & COMPANY, LIMITED, Staines.

NEW WELDING PLANT, with Acetylene Generator, six blowpipes, etc., ready for use, £17 5s.; complete new Cutting Plant, £15 10s. Lists free.—STANSELL'S ACETYLENE COMPANY, LIMITED, Exeter.

PATENT.

ADVICE and Handbook Free.—KINGI'S PATENT AGENCY, LIMITED, Director, B. T. King, Reg. Patent Agent, 146a, Queen Victoria Street, E.C.4.

MISCELLANEOUS.

PENCIL GANISTER, of high quality, and other grades for Sale.—Apply, R. E. ADAMSON, Ushaw Moor, County Durham.

OAK LOGS.—Buy now, at Lowest Summer Prices, from the Firm who makes them. Don't wait until the rush starts. Buy now. Price, f.o.r., 42s. 6d. per ton. Reduction on large orders. 500 tons in stock.—BALTIC SAW MILLS COMPANY, LIMITED, English Timber Merchants, in all its branches, Tunbridge Wells.

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Capacities and Dimensions furnished upon application.

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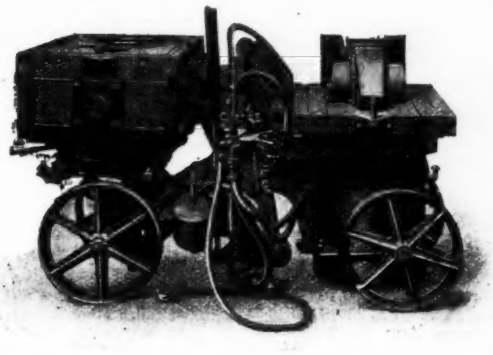

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Works: TOTTENHAM, LONDON, N.17.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	63	0	0
Three months	63	7	6
Electrolytic	70	5	0
Tough	65	15	0
Best selected	66	0	0
Sheets	94	0	0
India	84	0	0
Wire bars	70	15	0
Do. Sept.	70	15	0
Do. Oct.	70	15	0
Ingot bars	70	10	0
H.C. wire rods	75	15	0
Off. aver. cash, Aug.	63	18	9 9/11
Do. 3 mths., Aug.	63	19	2 5/11
Do. Settlement Aug.	63	16	11 2/11
Do. Electro, Aug.	70	8	7 7/11
Do. B.S., Aug.	67	6	8
Aver. spot price, copper, Aug.	63	16	1½
Do. Electro, Aug.	70	18	7½
Solid drawn tubes			13½d.
Brazed tubes			13½d.
Wire			10½d.
Yellow metal rods			6½d.
Do. 4x4 Squares			8½d.
Do. 4x3 Sheets			9½d

BRASS.

Solid drawn tubes	11½d.
Brazed tubes	13½d
Rods, drawn	10½d.
Rods, extruded or rolled	6½d.
Sheets to 10 w.g.	10d.
Wire	9½d.
Rolled metal	9½d.

TIN.

	£	s.	d.
Standard cash	159	10	0
Three Months	159	17	6
English	159	0	0
Bars	161	2	6
Chinese	158	2	6
Straits	160	2	6
Australian	160	2	6
Eastern	162	10	0
Banca	159	15	0
Off. aver., cash, Aug.	160	1	0 3/11
Do. 3 mths., Aug.	160	3	4 10/11
Do. Sttlment. Aug.	160	1	7 1/11
Aver. spot, Aug.	160	0	5½

SPELTER.

	£	s.	d.
Ordinary	31	5	0
Remelted	30	0	0
Hard	23	10	0
Electro 99.9	34	5	0
English	31	12	6
India	24	0	0
Prime Western	31	10	0
Zinc dust	48	0	0
Zinc ashes	9	0	0
Off. aver., Aug.	30	16	3
Aver., spot, Aug.	31	3	5

LEAD.

	£	s.	d.
Soft foreign ppt	24	10	0
English	25	10	0
Off. average, Aug.	24	3	10 4/11
Average spot, Aug.	24	11	8½

ZINC SHEETS.

	£	s.	d.
Zinc sheets, English	37	10	0
Do. V.M. ex. whf.	38	0	0
Dutch	37	10	0
Rods	42	0	0
Boiler plates	35	10	0
Battery plates	36	0	0

ANTIMONY.

	£	s.	d.
English regulus	25	15	0
Special brands	32	10	0
Chinese	23	10	0
Crude	14	15	0

QUICKSILVER.

Quicksilver 12 10 0 to 12 15 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
45/50%	£12 5 0
75%	£21 10 0
Ferro-vanadium—	
35/40%	17/6 lb. va.
Ferro-molybdenum—	
70/75%	7/9 lb. mo.
Ferro-titanium—	
23/25%, carbonless	1/3 lb.
Ferro-phosphorus, 20/23%	£20
Ferro-tungsten—	
80/85%, carbon free	1/5 lb.
Tungsten metal powder—	
98/99%	1/9½ lb.
Ferro-chrome—	
4/6% car.	£23 0
6/8% car.	£22 10
8/10% car.	£22 0
Ferro-chrome—	
Max. 2% car.	£60
Max. 1% car.	£68
Max. 0.70% car.	£75
67/70%, carbonless	1/6½ lb.
Nickel—99%, cubes or pellets	£150
Cobalt metal—98/99%	11/- lb.
Aluminium—98/99%	£100
Metallic Chromium—	
96/98%	5/- lb
Ferro-manganese (net)—	
76/80%, loose	£15
76/80%, packed	£16
76/80%, export	£14 10
Metallic manganese—	
94/96%, carbonless	2/4 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	s. d. 2 6
Finished bars, 18% tungsten	3 0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. to 8 in. inclusive 4d. lb.
Rounds and squares under ½ in. to ¼ in. 3d. lb.
Flats under 1 in. by ½ in. to ½ in. by ¼ in., and all sizes over four times in width over thickness 3d. lb.
Bevels of approved sizes and sections 6d. lb.
If in coils 3d. lb.
Packing £3 ton.
Bars cut to length 10% extra

Scrap from high-speed tool steel—
Scrap pieces 3d.
Turnings and swarf 1d

Per lb. net, d/d steel makers' works.

SCRAP

South Wales—	£	s.	d.	£	s.	d.
Heavy Steel	3	7	6	3	12	6
Bundled steel & shearings	2	17	6	3	5	0
Mixed iron & steel	2	17	6	3	2	6
Heavy cast iron	3	5	0	3	17	6
Good machinery for foundries		4	0	0		
Cleveland—						
Heavy steel		3	5	0		
Steel turnings		2	7	6		
Cast-iron borings		2	7	6		
Heavy forge		3	12	6		
Bushelled scrap		3	2	6		
Cast-iron scrap		3	7	6		
Lancashire—						
Cast iron scrap		4	0	0		
Heavy wrought		3	10	0		
Steel turnings		2	2	6		

London—	£	s.	d.
Copper (clean)	36	0	0
Brass (clean)	30	0	0
Lead (less usual draft)	20	0	0
Tea lead	18	0	0
Zinc	17	0	0
New aluminium cuttings	60	0	0
Braziery copper	46	0	0
Gun metal	40	0	0
Hollow pewter	125	0	0
Shaped black pewter	80	0	0

Above are merchant's buying prices delivered yard.

PIG-IRON.

N. E. Coast—	
Foundry No. 1	95/-
Foundry No. 3	87/6
Forge No. 4	84/-
Mottled	80/-
Hematite No. 1	89/6
Hematite M/Nos.	89/-
Midlands—	
Staffs. common	—
„ part-mine forge	—
„ „ foundry	—
„ Cold blast	240/-
„ basic	—
Northants forge	70/- to 72/6
„ foundry No. 3	77/6 „ 80/-
„ basic	82/6
Derbyshire forge	75/-
„ foundry No. 3	82/6
„ basic	80/-
Scotland—	
Foundry No. 1	102/6
„ No. 3	97/6
Hematite M/Nos.	107/6
Sheffield (d/d district)—	
Derby forge	82/6
„ foundry No. 3	86/6
„ basic	—
Lincs. forge	86/6
„ foundry No. 3	86/6
„ basic	86/6
E.C. hematite	100/-
W.C. hematite	105/-

All d/d in the district.

Lancashire (d/d eq. Man.)	
Derby forge	—
„ foundry No. 3	92/6
Northants foundry No. 3	—
Cleveland foundry No. 3	—
Staffs. foundry No. 3	—
Lincs. forge	—
„ foundry No. 3	—
Summerlee foundry	113/6
Glengarnock foundry	115/6
Gartsherrie foundry	115/6
Monkland foundry	113/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.
Bars (cr.)	£10 10 to 11	10	0
Angles	£11 to 11	10	0
Tees to 3 united ins.	£11 10 to 12	0	0
Nut and bolt	9	17	6
Hoops	14	0	0
Marked bars (Staffs.)	13	10	0
Gas strip	11	2	6
Bolts and nuts, ½ in. × 4 in.	18	10	0
Steel—			
Ship plates	£9 to 9	10	0
Boiler plates	12	10	0
Chequer plates	10	10	0
Angles	£8 15 to 9	0	0
Tees	£9 12 6 to 10	0	0
Channels	8	10	0
Joists	9	0	0
Rounds & squares 3-in. to 5½in.	10	0	0
Rounds, under 3in. to ½in.	9	10	0
Flats, over 5in. wide and up	10	0	0
Flats 5in. to 1½in.	8	10	0

	£	s.	d.
Rails, heavy	8	15	0
Fishplates	14	10	0
Hoops	11	10	0
Black sheets, 24 g.	12	0	0
Galv. cor. sheets, 24 g.	16	10	0
Galv. fencing wire, 8 g. plain	16	0	0
Rivets, ½ in. dia	13	0	0
Billets, soft	7 0 0 to 7	5	0
Billets, hard	8	0	0
Sheet bars	7 0 0 to 7	7	6

PHOSPHOR BRONZE.

	Per lb. basis
Strip	1 3
Sheet	1 3½
Wire	1 3½
Rods	1 2½
Tubes	1 6
Castings	1 1

Delivery 3 cwt. free to any town.

10% phosphor copper, £40 above price of B.S.

15% phosphor copper, £50 above price of B.S.

Phosphor tin (5%), £30 above price of English ingots.

CHARLES CLIFFORD & SON LIMITED, BIRMINGHAM.

NICKEL SILVER, SHEET METAL, WIRE AND TUBES.

	Per lb.
Ingots for raising	11d. to 1/5
Rolled—	
To 9 in. wide	1/5 to 1/11
To 12 in. wide	1/5½ to 1/11½
To 15 in. wide	1/6 to 2/0
To 18 in. wide	1/6½ to 2/0½
To 21 in. wide	1/7½ to 2/1½
To 25 in. wide	1/8½ to 2/2½
Ingots for spoons and forks	11d. to 1/5
Ingots rolled to spoon size	1/2 to 1/8
Wire round—	
3/0 to 10. G.	1/8½ to 2/3½

with extras according to gauge

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	33.14
No. 2 foundry Valley	33.00
No. 2 foundry, Birm.	20.00
Basic	27.96
Bessemer	31.76
Malleable	33.46
Grey forge	34.76
Ferro-manganese 80 % delivered	70.82
Bess. rails, h'y, at mill	40.00
O.-h. rails, h'y, at mill	40.00
Bess. billets	37.50
O.-h. billets	37.50
O.-h. sheet bars	37.50
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.32
Steel bars	2.00
Tank plates	2.00
Beams, etc.	2.00
Skelp, grooved steel	2.00
Skelp, sheared steel	2.00
Steel hoops	2.75
Sheets, black, No. 28	3.35
Sheets, galv., No. 28	4.35
Sheets, blue an'l'd, 9&10	2.50
Wire nails	2.60
Plain wire	2.35
Barbed wire, galv.	3.15
Tinplate, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	35/- to 40/-
„ furnace	30/- to 32/6
Durham & North. foundry	28/-
„ furnace	23/6
Other Districts, foundry	27/6
„ furnace	22/6

SWEDISH IRON.

Bars, hammered basis sizes Basis price £22 to £23

Rolled Ordinary—Assortment .. £17 0 0 to £17 10 0

Nail Rods—Square, round and flats .. £17 0 0 to £17 10 0

Keg Steel nom. £38 to £40

Faggot Steel nom. £30 to £32

Blooms—Single welded .. £10 to £11

Billets—Single and double welded £13 to £14

Pig-Iron—Grey, white or mottled .. £8 to £8 15 0

Prices are without engagement. All quotations are f.o.b. Gothenburg, net cash against documents there.

TUBES.

Up to and incl. 6 in.

Gas .. 55% } Tube prices
Water .. 50% } are
Steam .. 45% } now free.

TINPLATES.

I.C. Cokes,	20×14, box	19/3
„	28×20, „	38/6
„	20×10, „	27/9
„	18¾×14, „	19/7½
I.X.	,	44/6
I.X.X.	„	51/6
F.C.B.Y.	21×13⅝ „	37/–
C.V.B.G.	16¾×15, „	35/6
I.C.W.	20×14, „	17/–
„	28×20, „	33/9
„	20×10, „	23/3
„	18¾×14, „	17/3
Terneplates,	28×20, „	34/–

DAILY FLUCTUATIONS.

Standard Copper (cash).

	£	s.	d.		
Aug. 30	62	17	6	inc.	7/6
„ 31	62	15	0	dec.	2/6
Sept. 1	63	2	6	inc.	7/6
„ 4	63	2	6	No change	
„ 5	63	0	0	dec.	2/6

Electrolytic Copper.

Aug. 30	69	0	0	inc.	5/–
„ 31	69	5	0	„	5/–
Sept. 1	69	10	0	„	5/–
„ 4	70	0	0	„	10/–
„ 5	70	5	0	„	5/–

Standard Tin (cash).

Aug. 30	160	7	6	inc.	17/6
„ 31	160	10	0	„	2/6
Sept. 1	160	17	6	„	7/6
„ 4	159	12	6	dec.	25/–
„ 5	159	10	0	„	2/6

Tin (English ingots)

Aug. 30	159	17	6	inc.	17/6
Aug. 31	160	0	0	inc.	2/6
Sept. 1	160	10	0	„	10/–
„ 4	159	2	6	dec.	27/6
„ 5	159	0	0	„	2/6

Zinc Sheets (English).

Aug. 30	37	0	0	No change	
„ 31	37	0	0	„	
Sept. 1	37	0	0	„	
„ 4	37	0	0	„	
„ 5	37	10	0	inc.	10/–

Spelter (ordinary).

Aug. 30	30	17	6	dec.	2/6
„ 31	30	17	6	No change	
Sept. 1	31	2	6	inc.	5/–
„ 4	31	7	6	„	5/–
„ 5	31	5	0	dec.	2/6

Lead (English).

Aug. 30	25	10	0	No change	
„ 31	25	10	0	„	
Sept. 1	25	10	0	„	
„ 4	25	10	0	„	
„ 5	25	10	0	„	

JOHN HALL & CO.,
OF STOURBRIDGE, LIMITED,
STOURBRIDGE, ENGLAND.

Manufacturers of
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BARS, HOOPS, SECTIONS & WIRE
in IRON, STEEL, COPPER and BRONZE.
Galvanised Telegraph, Telephone, Cable and Trolley Wire
To all Specifications.
Contractors to H.M. Government (Admiralty, G.P.O., India Office, War Office, Colonies), English and Foreign Railways, &c.
BEST H. C. COPPER & BRONZE WIRE a speciality.
Medals:—Sydney (Bronze) 1879, New Zealand (Gold) 1882, Liverpool (Silver) 1886, Adelaide (Gold) 1887, France-British Grand Prix (Highest Award) 1908.

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EXCHANGE BLDGS., PORT TALBOT
5, MURZBAN ROAD, BOMBAY.
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31, RAFFLES PLACE, SINGAPORE.
JAVA STREET, KUALA LUMPUR.
5 SHAFFRAZ ROAD, RANGOON.
COX'S BUILDINGS, KARACHI.
PIG IRON
SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.
FOUNDRY COKE
COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.
WILLIAM COLVIN & COMPANY,
ROYAL EXCHANGE, MIDDLESBROUGH.
93, HOPE STREET, GLASGOW.

SITUATIONS VACANT AND WANTED.

MOULDER REQUIRES STEADY AND PROGRESSIVE JOB. Accustomed to complete control. Motor and General Engineer and Jobbing. Personally operating Cupola and other Furnaces, making oil-sand jacket cores, and supplying castings to analysis. Iron, Aluminium and Bronze. Good Technical and Practical: Mathematics, Mechanics, Chemistry, Physics, Metallurgy, Iron and Steel Manager and Mechanical Drawing. Good knowledge of costs, and could assist in Drawing Office, Pattern Shop or any department of Foundry. I.B.F. and B.C.I.R.A. Man. — Apply: F. A., c/o Ignition Laboratory, 57, Union Street, Oldham, Lancs.

ADVERTISER, Age 39, seeks position as Non-ferrous FOUNDRY MANAGER. Twenty-five years' practical experience. Thorough knowledge of up-to-date plant and practice. Unimpeachable references. Address, in first instance, Box 212, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

INDIAN REPRESENTATION.

SCOTCHMAN, with 14 years' COMMERCIAL EXPERIENCE IN INDIA, open to negotiate with Iron and Steel, Paint and Varnish, Engineer and Small Tool, Agricultural Tool, Brassfoundry, Cutlery, Hardware, Manufacturing and Exporting Firms, with a view to representation in India. Keen worker. Splendid References. Apply, "A.R.A.," c/o FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

FOREMAN MOULDER WANTED AT ONCE in S. Wales district; he must be thoroughly experienced in the rapid production of steel, iron, and brass castings, expert knowledge of machine moulding and pattern plates essential, and able to control a large number of men. State age, experience, and salary required. Apply, Box 244, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

REQUIRED FOR INDIA. Experienced Iron Foundry Foreman, must be I.B.F. man. Apply, Box No. E.D., Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, Strand, London, W.C.2.

WANTED.—HIGHLY CAPABLE FOREMAN for GENERAL IRONFOUNDRY of 100 hands. (Castings ½ to 10 tons.) Must be keen to a degree in economical production of non-repetition work, and up-to-date both practically and theoretically in every detail of foundry practice. Estimating and diplomatic handling of employees necessary. State age (not over 38), positions held, periods and employers, also salary required, to Box 248, Offices of the FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, Strand, London, W.C. 2.

TENDERS.

RENFREW.

IRON FOUNDRY AND SMELTING WORKS FOR SALE.

FOR SALE, the IRON FOUNDRY and SMELTING WORKS belonging to A. MACAULAY & COMPANY, LIMITED, RENFREW, now in Liquidation:—

1. The Iron Foundry, having a frontage to Brown Street, Renfrew, consists of:—
   Main Foundry Building, Mechanics' Shop, Dressers' Shed, Bogie Rail Track, Plant and Machinery, etc. Electric Light Installation.
   Extent of ground, 1 acre or thereby. Feu duty, £23 0s. 5d. Casualties redeemed.
2. The Smelting Works, having a frontage to French Street, Renfrew, of about 162 feet, consist of:—
   Main Building forming Smelting Works, Melting Furnaces, Plant and Machinery, Offices, Store, Washhouse, Petrol Store and Tanks.
   Extent of ground, 1 acre, 2 poles, 19 square yards, or thereby. Feu duty, £18 17s. 6d. Casualties redeemed.

Offers marked "Tenders for Macaulay's Iron Foundry and Smelting Works" are invited for both Works, or for each Work separately, and should be lodged with the Liquidator, R. H. Ballantine, C.A., 116, Hope Street, Glasgow, not later than Wednesday, September 27, 1922.

For further particulars and cards to view, apply to J. Wyllie Guild and Ballantine, C.A., 116, Hope Street, Glasgow, or to Anderson Fyfe Littlejohn & Company, Solicitors, 201, West George Street, Glasgow.

TENDERS (*continued*).

GALVANISED Iron or Steel Tubular Poles for Telegraph Poles, 20 ft. long, 1,500, Schedule 755. Tenders are invited by the Commonwealth of Australia for the above, receivable in Australia on 15th November.—For tender, forms, and full particulars, apply SUPPLY OFFICER, Room 101, Australia House, Strand, London, W.C.2.

AUCTION SALE.

By direction of the Right Hon. the Viscount Hood.

NORTHAMPTONSHIRE.

Within 2 miles of Kettering (M.R. main line); 7 miles from Wellingborough; Cranford Station (M.R.) and Butlins Sidings adjoining.

THE IMPORTANT FREEHOLD AGRICULTURAL AND MINERAL PROPERTY
known as
"THE BARTON SEAGRAVE ESTATE,"

lying within a ring fence, in the Parish of Barton Seagrave, near to the town of Kettering, bounded by good hard roads, intersected at the south-east corner by the Midland Railway, and containing an area of about

854 ACRES, with the

VALUABLE BEDS of IRONSTONE lying thereunder.

To be Offered for Sale by Auction as a whole, or in 2 lots (if not previously disposed of by private treaty), by

BERRY BROS. & BAGSHAW,

at the George Hotel, Kettering, on Friday, September 8th, 1922, at 4 o'clock in the afternoon precisely.

Particulars, with Plans, may be obtained of the Solicitors, Messrs. Broughton, Holt & Middlemist, 12, Great Marlborough Street, London, W.1.

Land Agents: Messrs. Fisher & Co., Market Harborough.

Auctioneers: Messrs. Berry Bros. & Bagshaw, Kettering.

MACHINERY.

FOR SALE.

Two new Thompson Dish-ended Lancashire Boilers, 30 ft. x 8 ft. 3 in., for 150 lbs. pressure. Three Lancashire Boilers, 30 ft. x 7 ft. 6 in., now insured at 150 lbs. pressure. Two Cornish Boilers, 28 ft. x 6 ft. diameter, reinsure 90 lbs. pressure. Four Marine Water Tube Boilers, by Yarrow, Limited, each 4,000 sq. ft. heating surface, reinsure 200 lbs. pressure. One Loco Type Boiler, barrel 7 ft. 6 in. long x 3 ft. diameter, reinsure 80 lbs. pressure. One Vertical Boiler, 6 ft. 6 in. x 3 ft. 9 in. diameter, reinsure 80 lbs. pressure. One Hornsby Waste Heat Water Tube Boiler, about 40 h.p., reinsure 160 lbs. pressure. Air Receivers, 6 ft. x 2 ft. 6 in., tested to 90 lbs. pressure, with safety valve, drain cock, etc.

Catalogue of Stock Machinery, 5-6,000 Lots.
Free on Application. Inspection Invited.

THOS. W. WARD, LTD.,
ALBION WORKS,
SHEFFIELD.

FOR SALE.—TIPPING TYPE CRUCIBLE FURNACE by GREEN, 400-lbs. capacity, complete with fan. Particulars and price from Hoe, 109, Borough Road, London, S.E.1.

ONE 20-in. CENTRIFUGAL FOUNDRY SAND MIXER, capacity 1 to 2 tons per hour, fitted with latest improvements and equal to new.—Price and particulars on application to C. E. V. HALL, 26, Paradise Square, Sheffield.

(*Continued on page* 206.)

CUPOLAS

30-in. ALLDAY'S CUPOLA with hoist, staging, 20ft. by 10ft. and roof, complete installation £150 f.o.r., standing in London.

42-in. WHITING CUPOLA, with spark arrester, staging hoist, etc., ready for immediate use, and complete in every detail, £380 f.o.r. London, for the entire plant, including 3 phase, 50 cycle, 415 volt electric hoist, and electric blower, same voltage.

URGENTLY REQUIRED

2-ton stock oil-fired converter. Two small tilting cupolettes. Also **all kinds** of surplus foundry plant **for re-sale.** Please send offers to—

ALEXANDER HAMMOND,
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